Marine Energy Test Centre

Environmental Statement

July 2002

Report Status: Final

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Section 36 Consent

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1. Introduction

1.1. Introduction

Highland and Islands Enterprise wish to commission a Marine Energy Test Centre (METC) on the south west corner of the mainland island of Orkney. The centre will provide the infrastructure facilities for carrying out testing of up to four offshore wave energy electricity generating devices.

Wave power represents a potentially huge resource of environmentally sound renewable energy and provides an opportunity to attract investment to many of the less favoured areas of Scotland.

This document has been prepared to identify potential environmental impacts of the development and record the measures, which are proposed to mitigate these impacts.

1.2. Scope of this Environmental Statement

Site option studies identified two suitable marine energy test sites; one site, to the west of Stromness suitable for testing devices designed to take energy from waves, and one to the south east of Stromness suitable for testing devices designed to take energy from undersea currents. An environmental impact scoping study was prepared for developing the necessary infrastructure at these sites and a copy is included in Appendix A of this document.

Since the scoping study was completed the proposed scheme has been modified to include only the wave energy site to the west of Stromness and developed by the design team taking cognisance of information provided by two wave energy device developers who are planning to use the test facility. This report has therefore focussed on the areas of the environment, identified in the scoping study, which will be affected by the proposed development, as currently planned.

The wave energy generating devices and their anchorage's form an integral part of the proposed development, however the exact nature of the test devices, which will be moored off shore, is not known at this stage. A detailed environmental impact assessment can therefore not be carried out on this element of the proposed development. Nevertheless a proposed operational environmental framework has been included, which seeks to address the principal off shore environmental issues identified during the preparation of this document, to allow permissions/consents to be obtained, subject to any additional detailed information requirements being provided, prior to the devices being brought on site.

The Marine Energy Test Centre Operating Company will develop this environmental framework, and monitor the environmental performance of the generating devices, once it has been appointed by Highlands and Islands Enterprise.

Highlands and Islands Enterprise have commissioned Scottish and Southern Energy to construct the electrical connection from the island's main electrical grid, to the switchgear building at Billia Croo, which receives the electrical cabling from the offshore devices. The environmental impact of this work is not included in this document.

1.3. Report Structure

This report is divided into sections, each of, which address one specific aspect of the environment upon which the development will impact. Where detailed technical information has been prepared on a specific aspect, it is included in the appendices, for reference. Where mitigating measures have been adopted during the design development, these are identified under the relevant section. A non-technical summary has been included to make the information more accessible to the general reader.

2. The Proposal

2.1. Background to the Project

The UK government has acknowledged the need to increase the quantity of energy generated from renewable sources and has set future targets in this regard. Scotland has huge potential for the generation of renewable energy from both offshore wind and waves, with onshore wind energy being most developed. The generation of electricity from the marine environment is at an early stage of development, with a number of companies currently designing and building full-scale devices for testing.

In order to encourage the development of this new industry, which has the potential to bring significant investment and work to some of the less favoured areas of Scotland, Highlands and Islands Enterprise are proposing to construct the infrastructure which will allow wave energy devices to be tested under working conditions and allow their generating capacity to be verified, in order that further investment can be obtained for establishing this technology on other offshore sites.

Three main drivers have governed the design of the project; firstly the facility has to function satisfactorily for the purpose for which it is designed, secondly, it has to be constructed to a pre-defined budget and thirdly it must minimise adverse impacts on the existing environment. Through this document we seek to demonstrate the third item of these constraints has been satisfactorily addressed.

2.2. Site Selection

A site assessment study was commissioned by Highlands and Islands Enterprise to find the most suitable site for a Marine Energy Test Centre. Hoy Mouth (in which Billia Croo bay is situated) was one of several locations in Scotland to be assessed.

This site in Orkney came out on top in several of the 18 categories used to judge the possible locations; namely: -

- Available energy resources;
- Shortest distance to offshore to exploit resources;
- Availability of offshore support facilities;
- Proximity of sheltered water for construction purposes;
- Suitability of connections to main electrical grid.

Of the two proposed sites in Hoy Mouth the one at Billia Croo bay was identified as the best option due to the better natural landing point for the offshore cables.

2.3. Proposed Project

2.3.1. Overview

It is proposed that the project provides the infrastructure to allow up to four offshore wave energy devices to be tested and comprises of the following elements: -

- The refurbishment of four rooms within the Old Academy building in Stromness to provide offices as a control centre for the facility;

- A new reinforced concrete switchgear building at Billia Croo with an access track connecting it to the existing public roadway;

- Four 100mm (approx.) diameter electrical cables, which run from the switchgear building at Billia Croo to each of the four wave energy device mooring positions offshore, approximately 1.5km offshore;

- Seabed anchors at the seaward end of each of the electrical cables;

- The existing redundant coastguard's lookout building on Black Craig hill will be re-used as a housing for CCTV cameras to visually monitor the offshore devices. This building will be connected to the switchgear building at Billia Croo with underground electrical and communications cables.

2.3.2. Site Details

The site for the switchgear building at Billia Croo, which is approximately 2 miles to the west of Stromness, lies within a National Scenic Area (NSA). The surrounding land, which is used for arable agriculture, slopes westwards towards the sea with a steeply sloping section immediately above high watermark. The adjacent beach, over which the electrical cables are routed to the offshore devices, is identified as a Site of Special Scientific Interest (SSSI), due to it's unique geology.

The redundant coastguard's lookout building on Black Craig hill is also located within a Site of Special Scientific Interest (SSSI) and candidate Special Area of Conservation (cSAC) due to its heathland grasses and flowers and associated breeding bird species. Copies of the maps indicating the boundaries of these areas together with the citation are included in Appendix E for information.

2.3.3. Billia Croo Switchgear Building - Proposed Layout and Appearance

This building is required to house electrical switchgear and conditioning equipment where the electrical transmission cables come ashore from the wave energy testing devices offshore. It is also required to house a small emergency diesel powered electrical standby generator, in case of supply outages. The approximate size of this building is 15m long by 5m wide by 4m high.

In order to minimise the visual impact of the building is it designed as a reinforced concrete underground structure, which will be completely buried, with the exception of a roof ventilation cowling, a handrail and part of the south facing wall, which requires to be exposed to allow access and ventilation.

It is proposed to locate the building below ground level, at the top of the steeply sloping ground above the high tide level, adjacent to an existing small stream. The location was chosen to provide the maximum height above sea level to avoid possible flooding during storms or high tides, but maintain the structure below ground level to minimise visual intrusion and as protection against airborne rocks and other debris during bad weather conditions.

By choosing this location the surrounding ground can be reinstated to reflect it's existing form, with the exception of the area to the south of the new building where the new track and turning head is required to provide vehicular access to the building. Consequently, the one partly exposed face of the building will only be visible from the south west, or from the south, when the viewer is close to the new building. Otherwise it will only be the hand railing, ventilation cowling and access

track, which will be visible. It is proposed to clad the partly exposed face of the building with the local grey natural stone in order to blend in as much as possible with surrounding landscape.

There is no permanent staffing requirement for this building, access is required only for intermittent maintenance and for an inspection.

The diesel tank for the emergency generator is located within a bund within the building.

The building details and associated earthworks are indicated on drawing nos. 1543/51 and 1543/52, included in Section 16.

2.3.4. Redundant coastguard's lookout building on Black Craig Hill – Proposed Changes

This existing building is a small rendered blockwork structure with a reinforced concrete flat roof. The building is no longer used for its original purpose as coastguard lookout post and has fallen into disrepair. It no longer has any windows or doors – Refer photographs 7.1 and 7.2. It is proposed that two CCTV cameras are located in this building and that it is refurbished to provide a secure building envelope for the cameras, by means of a lightweight galvanised steel mesh over the existing window and door openings.

Electrical and communications cables require to be laid to this building from the Billia Croo switchgear building, for the CCTV cameras. These cables will be laid underground. Trenches will therefore be required to be excavated through the SSSI / cSAC area. It is therefore anticipated that specific measures will be required to minimise the damage to the existing turf by carefully lifting and relaying during the trenching works and timing this work to minimise disturbance to indigenous wildlife.

The proposals are indicated on drawing no. 1543/55, included in Section 16.

2.3.5. Old Academy, Stromness – Proposed Control Centre

Parts of the Old Academy building are currently used as office accommodation by a number of different organisations. It is proposed that four of the rooms within the building, which are currently vacant, will be refurbished for office space for use by the operators of the test centre and by the wave energy device manufacturers. This is the only part of the new facility, which will be staffed on a daily basis.

2.3.6. Access

There is only one public access road to the site, from Stromness, which consists of a surfaced, single-track road. Both temporary construction and permanent vehicular access is required to the Billia Croo switchgear building and will be provided by upgrading and extending the existing farm track, which currently provides farm access the fields in the vicinity of the proposed location of the switchgear building. A hardcore track approximately 3.0m wide will be provided from the end of the public roadway to the new switchgear building, as indicated on drawing no. 1543/50, included in Section 16. The use of this track will be shared by the existing landowner, the contractor during the construction period, and the facility operator, on completion of construction.

No vehicular access is required to the redundant coastguard's lookout building on Black Craig Hill.

2.3.7. Offshore Cabling

One armoured electrical cable, approximately 100mm in diameter will run from the switchgear building at Billia Croo to each of the four offshore mooring locations for the wave energy generating devices. The cables will be buried in a trench approximately 1.5m wide from the switchgear building, to Low Water Mean Spring Tide level, beyond this point it will be laid on the seabed. Within the beach and surf zone adjacent to the shoreline, the cables will have additional cast iron protection sleeves fitted. In addition, along the length of the cable, where it crosses over sharp rock outcrops, it will also be fitted locally with additional cast iron protection sleeves. At the offshore mooring positions, a seabed anchor, of reinforced concrete, will be installed to anchor the end of the cable, before it rises to connect to the wave energy device. A fibre optic communications cable will be incorporated within each of the armoured cables.

2.3.8. Staffing

There is no permanent staffing requirement at either the switchgear building at Billia Croo or the old coastguard building on Black Craig Hill. Intermittent maintenance and inspection access to both the buildings will be required, which will be by car or van to the switchgear building at Billia Croo and by foot to the old coastguard building.

Facility operators will permanently staff the main control centre in the Old Academy, with office accommodation provided for visiting representatives from the wave energy device companies.

2.3.9. Construction

The construction work is currently planned around carrying out the weather dependant marine works during the summer months of 2003. Subject to obtaining the necessary planning permissions and funding, work will start on the access track and the switchgear building at Billia Croo in October 2002 in preparation for landing the offshore cables during May/June 2003.

The earthworks around the building have been designed to minimise the amount of material to be brought on to site, the soil and rock excavated for the switchgear building at Billia Croo will be used to reinstate the landform around the buried structure, consequently no spoil will required to be removed from the site. Heavy construction traffic will therefore be limited to delivery of road stone to upgrade and extend the existing track and for the reinforcement and concrete deliveries for the construction of the switchgear building.

Small tracked equipment will be used to install the cabling through the area of Special Scientific Interest on Black Craig Hill.

The offshore cables will be delivered to the site by boat and the landward end of the cables floated ashore for connection into the switchgear building.

It is anticipated that the works will be completed and operational by September 2003.

2.4. Project Procurement

The project is being procured in two distinct phases. The first phase being the design definition phase; which comprises developing the original brief to take cognisance of the numerous practical, physical, financial, legislative and environmental constraints which the facility must be constructed and operate within.

At the end of this phase, an agreed specification and cost will be defined and all the necessary permissions, leases etc. obtained to allow the project to proceed to construction.

The second phase includes the detailed design and construction to the agreed specification and cost.

The companies who won the commission to carry out the design development and construction are listed in Appendix B, for information.

3. The Environmental Assessment

3.1. Aims

The aim of the Environmental Statement carried out for this project is to identify the existing base line conditions, prior to the proposed works and to make an assessment of the likely impact which the works will have on the existing environment.

3.2. Approach

Utilising the information contained in the scoping study and our knowledge of the proposed works, baseline studies were carried out on those elements of the environment which were identified as being of particular significance; in the area of the proposed works, namely: -

- Offshore Ecology
- Onshore Ecology
- Archaeological Heritage
- Geology

These studies have then been used, in conjunction with the detailed proposals, to predict the effects both detrimental and beneficial that will occur due to the proposed works. The organisations, which carried out these specialist studies and contributed to this environmental statement, are listed in Appendix C, for information.

Cognisance has been taken of the guidance provide by EEC directive 85/337/EEC amended as 97/11/EC in 1997 and it's specific Scottish form, *The Town and Planning (Environmental Impact Assessment) (Scotland) Regulations 1999.*

3.3. Consultees and Interested Parties

During the preparation of the design, various organisations were approached for their views on the initial proposals to ascertain their concerns regarding the project. The organisations consulted included: -

- Orkney Islands Council, Department of Harbours;
- Orkney Dive Boat Operators Association;
- Orkney Fisheries Association;
- Orkney Fishermen's Society;
- Orkney Islands Sea Angling Association;
- SNH;
- SEPA;
- Orkney Field Club;
- Royal Society for the Protection of Birds;
- Chris Booth (the Orkney cetacean recorder);
- Sea Mammal Research Unit;
- British Geological Survey;
- Dr John Flett Brown.

Where applicable, responses from these organisations, or notes of meetings attended by them, are included in Appendix D. In addition, other local stakeholders have been made aware of the project through distribution of material by the Orkney Marine and Coastal Study Forum and by direct contact.

4. Offshore Ecology

4.1. Introduction

The offshore elements of the Marine Energy Test Centre comprise the installation of four electrical cables. The cables will be installed across the boulder shore in the centre of Billia Croo bay in a trench approximately 1.5 m wide down to the low water mean spring tide level. Beyond this point the cable will be laid on the seabed. Within the surf zone and at other potential vulnerable locations along the route (e.g. sharp rock outcrops), protection will be provided in the form of cast iron sleeves. The environmental assessment has therefore addressed the potential impact that the installation of these cables and the presence of test devices may have on the offshore ecology of the area.

Several surveys have been undertaken in preparation for the project, the data from which have all been made available for the Environmental Impact Analysis. These surveys include:

- Multibeam bathymetry at 1m spacing conducted by Fathoms for the whole of the wave site test area;
- Sidescan sonar conducted by Fathoms for the whole of the wave site test area;
- Multibeam bathymetry at circa 4 m spacing for the inner wave site test area, conducted by Gardline;
- Sidescan sonar for the inner area conducted by Gardline;
- A dive transect survey, undertaken by ICIT, Heriot-Watt University, extending shoreward from 20 m (video and stills photography);
- Dive site surveys, undertaken by ICIT, for seven stations within the wave site test area (video, still photography and fine sediment cores for future biological reference); and
- Littoral survey undertaken by ICIT in conjunction with Dr Martin Wilkinson of Heriot-Watt University (transects and species list).

The Marine Nature Conservancy Research (MNCR) biological survey (No. 449) data for the area summarised in Murray *et al*. 1999 has also been referred to. Multibeam data have been used to generate bathymetric maps and provide information on the changes in elevation (slope) and their orientation (aspect) and to provide hill shaded relief maps of the seabed. Sidescan data provide further information on the nature of seabed topography and substrata at small scales.

Data on the marine species present in this area offshore the west coast of Mainland Orkney have been provided by:

- General published texts;
- The Orkney cetacean recorder;
- Sea Mammal Research Unit (SMRU);
- Royal Society for the Protection of Birds (RSPB); and
- Data held in the OIC oil spill contingency planning database.

4.2. Existing Conditions

4.2.1. Summary of multibeam and sidescan survey data

Figure 4.1 shows the general bathymetry of the wave-site test area and Figure 4.2 the hill shaded relief topography associated with this. It can be seen that bedrock substrata is characteristic of much of the shoreline of this region and extends steeply into the infralittoral[1] zone. The underlying bedrock continues to dominate the circalittoral[2] zone, with the area of predominantly offshore sublittoral[3] sediment reached at around 45-47m.

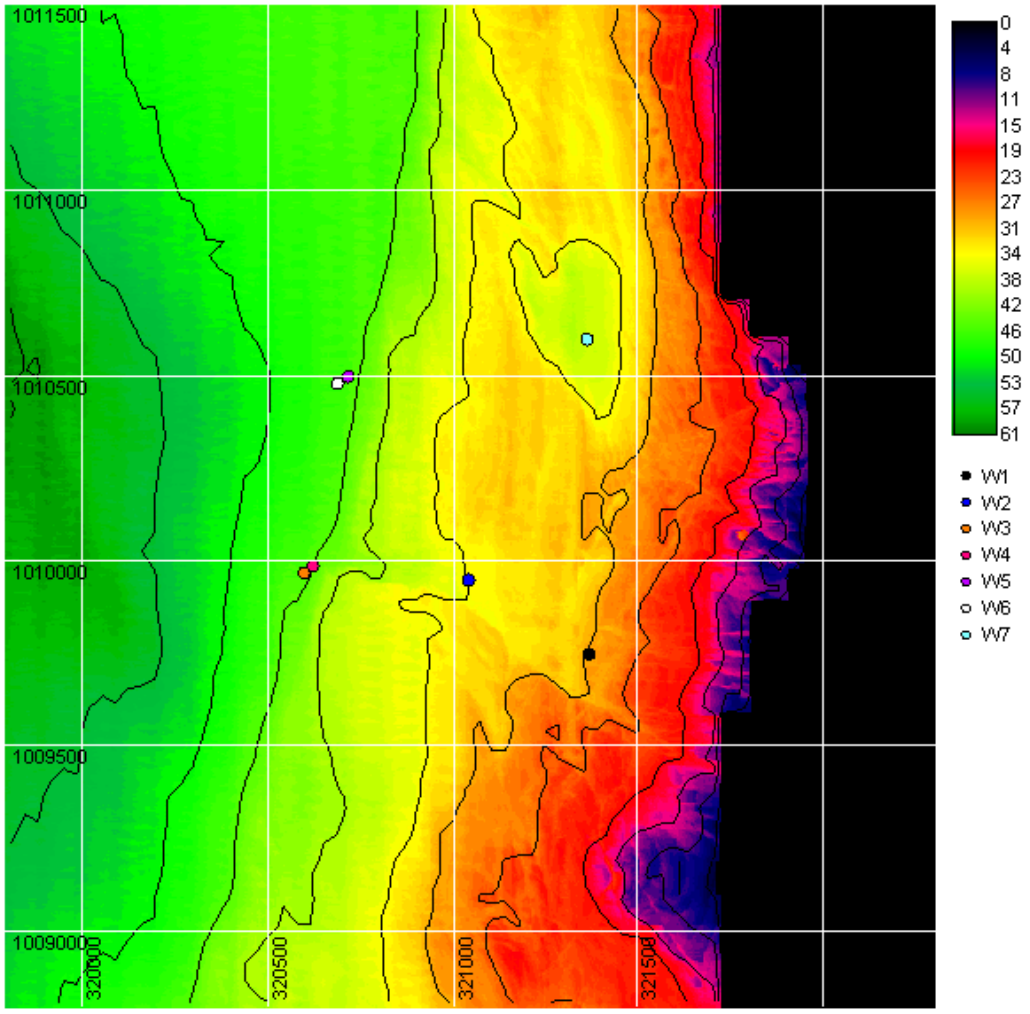

Figure 4.1
Bathymetry from multibeam data, showing dive survey sites

[1] The infralittoral is the shallow sublittoral zone dominated by kelps and seaweeds or wave disturbed sediment communities.
[2] The circalittoral is the deeper waters of the sublittoral zone characterised by animals.
[3] The sublittoral zone extends below the lowest tidal level.

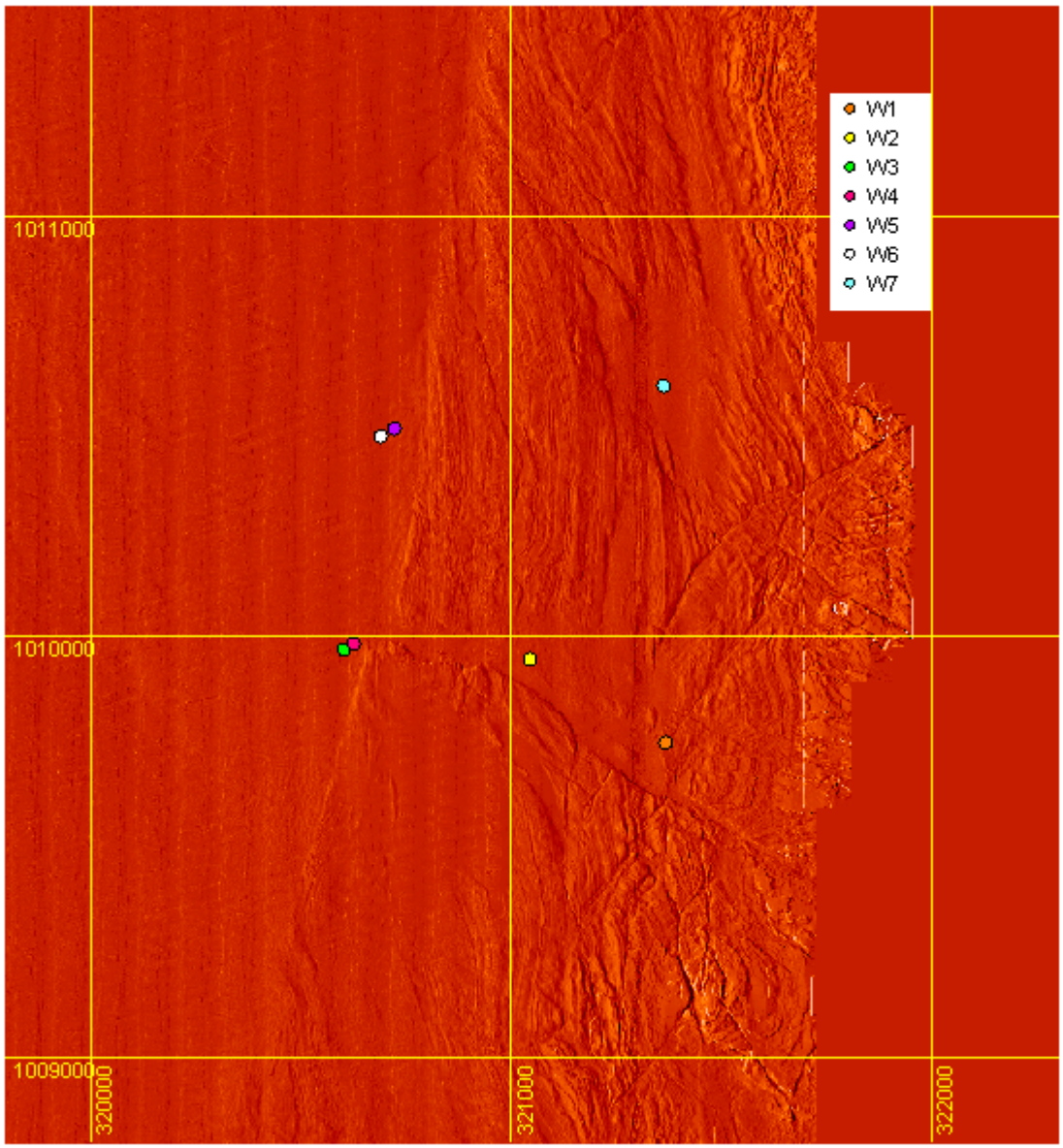

Figure 4.2
Hill shaded relief of seabed topography from multibeam data

Figure 4.3 shows an indicative diagram of sidescan imaging with the Gardline inner area survey superimposed over the Fathoms' data. The delineation of the seaward extent of bedrock corresponds reasonably well, and the sidescan data also show a mixed sediment cover of bedrock throughout many regions of the circalittoral zone. Fathoms data confirm these features on the original sidescan insonographs, which show greater detail. The dive survey sites W3 and W4, and W5 and W6 all confirm the impression that the dominant feature beyond 47 m is sand, interspersed with occasional boulder and stone cover. This description of the seabed environment has also been confirmed by observations made by local fishermen.

Bathymetry, slope, aspect and (at this stage only low-resolution) sidescan data have all been used to provide imaging bands for a supervised classification of the marine habitats, with biotope selection being governed by data from the dive surveys. Work-up of the biological sediment core samples and registered high-resolution sidescan will improve the biotope characterisation offered here, and Fathoms have kindly

agreed to provide Marine Energy Test Centre with the detailed raw side-scan data in a form appropriate for further biotope characterisation studies.

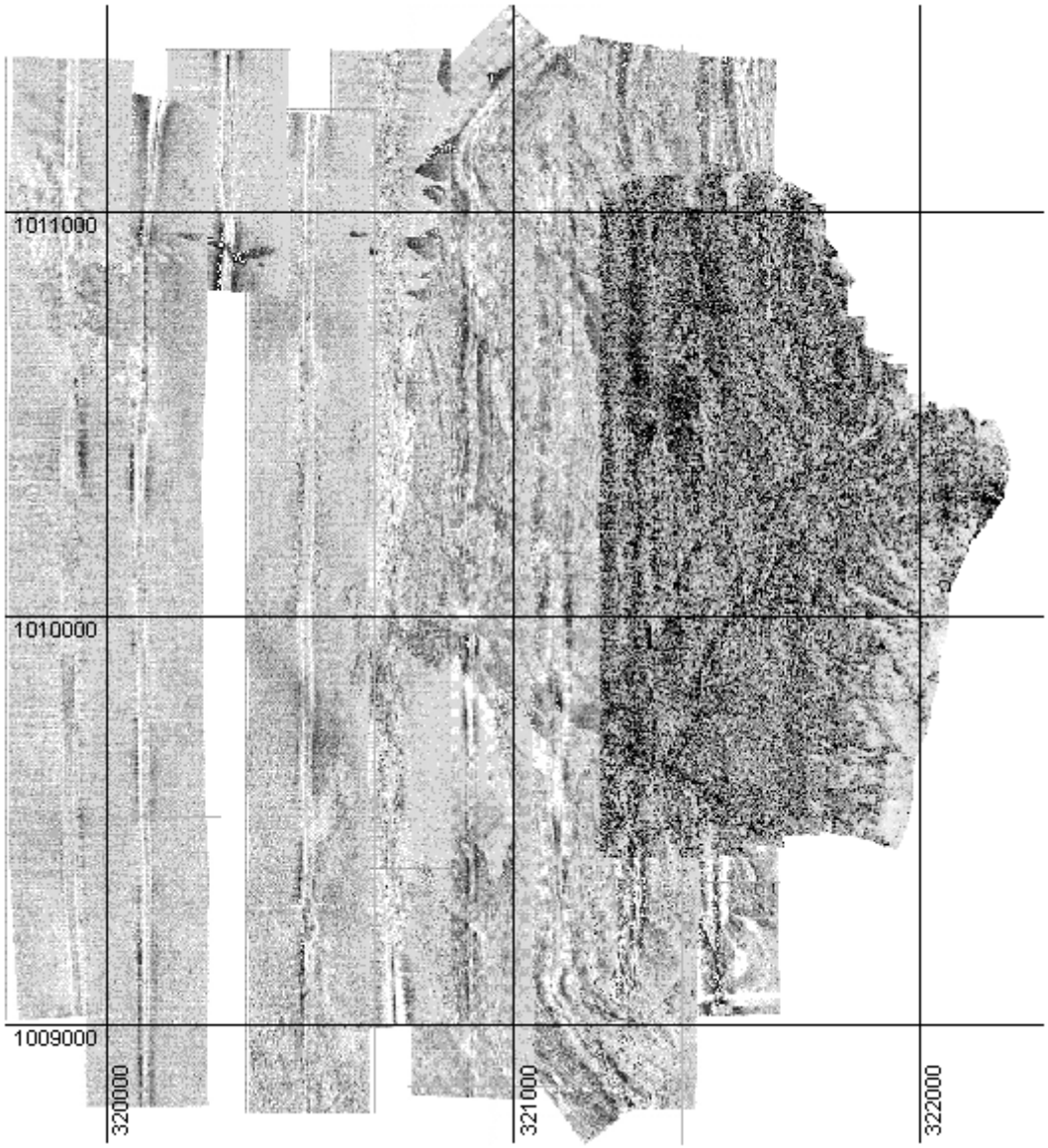

Figure 4.3
Areas covered by Fathoms (whole area) and Gardline (inner area) sidescan

4.2.2. Seabed ecology

General marine biotope description

The general picture of marine biotopes is shown in Figure 4.4. Close inshore and contiguous to the LWM, the infralittoral zone comprises exposed bedrock dominated by a cover of *Laminaria hyperborea*. There is a noticeable thinning of the density of kelp cover as the depth increases and a transition to a more complex mosaic of biotopes is seen, characteristic of circalittoral rock, around the 20-25 m isobath. These are illustrated in Figure 4.4 as a *Flustra foliacea* biotope on exposed rock, with a sediment veneer overlying this in many places. This covering includes a wide range of particle sizes from fine sand to large boulders, but the term “sediment veneer” is used to distinguish this from the underlying bedrock, which is also exposed in many places. While the *Flustra folicea* type biotopes are also evident on many boulder areas of the veneer, other biotopes can be found also in these conditions, such as the *Ophiothrix fragilis/Ophiocomina nigra* beds of brittlestars.

In other areas particularly of exposed bedrock and large boulders, the biotope is better described by *Alcyonium digitatum* with *Securiflustra securifron,* a biotope that is also visible in places in the infralittoral zone. In general, this biotope would be expected to dominate the higher energy areas and on vertical rock surfaces (areas distinguished on Figure 4.4 as prominent rock features). The precise seaward extent of exposed bedrock is difficult to determine, but there appears to be a general boundary at around 45-47m where the exposed bedrock is replaced by a deeper sublittoral sediment layer of fine sand, which itself is interspersed with boulder and stones. The sidescan images suggest that bedrock outcrops may also occur within this area making a definitive classification rather difficult.

Without detailed biological data it is difficult to summarise the biotope complexes of the offshore sediment, but the *Urticina felina* biotope (characterised by the Dahlia anemone) was observed at one of the dive sites in this area. The sidescan images suggest a degree of variability in the sediment characteristics and it is likely that other distinctive biotopes are present within the area of offshore sediment.

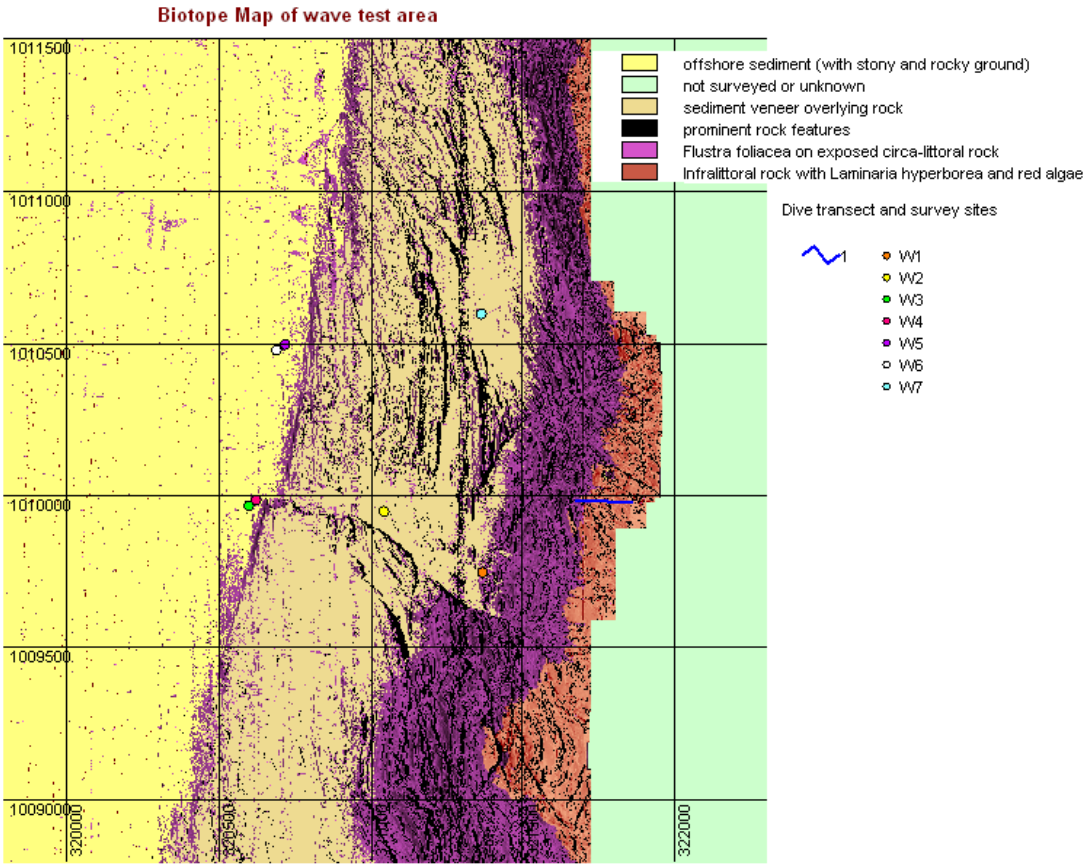

Figure 4.4
Distribution of principal marine biotopes showing dive sites and transect

The offshore environment described here is typical of Orkney coastal waters. The high and varying dynamics of tide and wave exposure, the varying topography and seabed types serve to produce complex mosaics of marine habitat types.

It should be noted that while the picture emerging from the multibeam bathymetry, sidescan survey and dive surveys shows much more complexity than that described by the JNCC MNCR (Murray *et al*. 1999) for this area, there is nonetheless a general consistency in the characterisation of the principal biotopes. This EIA biotope classification follows Murray *et al* (1999) in adopting the BIOMAR (Conner *et al*.,

1997) marine biotope classification system, which is to form the basis of the EUNIS European biotope classification system for the marine biotopes.

The infralittoral zone
In common with much of Orkney's exposed coast the infralittoral zone is characterised by the kelp *Laminaria hyperborea* biotope. The areas of *Alaria esculenta* on the sublittoral fringes were not observable from the dive surveys, but are not uncommon in this area and were recorded in the littoral survey. In shallower water, the kelp is foliose providing a thick canopy but thins gradually as the water deepens. Individual plants are observable as deep as 30 m but the dominance of this biotope is limited to around 20-25 m.

The bedrock in this area is characterised by steep sided gullies and other prominent rock features, many of which suggest its exposure above sea level in the Mesolithic period and earlier. In the deeper gullies even within the *Laminaria hyperborea* zone the biotope *Alcyonium digitatum* is clearly visible. The dive survey transect video and still photography show all of these features.

The circalittoral zone
The circalittoral zone appears dominated by the *Flustra foliacea* biotope, but this is interspersed by other communities able to exploit better the high-energy areas of exposed bedrock (such as *Alcyonium digitatum*) or the mixed sediment cover that overlies the bedrock in many areas. The grazing pressure of *Echinus esculentus* is also evident in places suggesting that grazing tolerant communities may also characterise some biotopes found with the circalittoral zone (See photo 4.3, section 14.3).

Ophiothrix fragilis/Ophiocomina nigra biotope dominates at dive site W7 See photo 4.18, section 14.3). To the south there is an area of relatively thick sand veneer within which ripples are clearly visible on both the sidescan images and multibeam bathymetry. There is at least one other area with a similar sand ripples, and at it is probable that the biotope characteristic of these regions differs again (possibly a polychaete dominated one).

The sublittoral offshore sediment zone
The boundary of circalittoral exposed bedrock and sublittoral sediment is not clear cut, and it is likely that areas of exposed bedrock protrude well beyond the 45 m isobath. Dive sites surveyed on this boundary show a range of biotopes from the *Flustra foliacea* characteristic of the exposed rock of the circalittoral to brittlestar dominated *Ophiothrix fragilis/ Ophiocomina nigra* also found in the overlying sediment of the circalittoral zone. The *Urticina felina* biotope is visible at dive site W6 suggesting that there is a high degree of sand scour on the boulder and stone patches in this region.

Dive sites W3 and W4, and W5 and W6 also show extensive areas of fine to coarse sand, which is likely to dominate the deeper waters of the sublittoral zone (See photo 4.18, section 4.13). While the brittlestar and *Flustra* biotopes will still be found where boulder and stone patches occur, there is probably further variation in the fine sand communities as well in this zone of sublittoral sand. The sidescan images in particular show little homogeneity for the sediment characteristics of this zone and it is likely that other biotope types not revealed by the dive surveys also occur. A simple cluster analysis on the sidescan images reveals the extent of variability of sediment types which can be related to further dive survey, ROV or biological sampling information as it becomes available.

Table 4.1
Detailed classification of the sublittoral marine biotopes within the habitat mosaic of the wave test site

HIGHER CODE (CONNER ET AL., 1997)	BIOTOPE CODE (CONNE R ET AL., 1997)	ZONES WHERE FOUND (SEE FIGURE 4.4)	DIVE SURVEY SITES	DESCRIPTION - FOR FURTHER DETAIL AND UK EXEMPLAR PHOTOGRAPHS SEE WWW.JNCC.GOV.UK/MERMAID/BIOT_FRAMES.HTM
EIR.KfaR	LhypFa LhypR.Ft LhypR.Pk	Infralittoral zone	Transect and MNCR Survey No 449.	Dominated by the kelp Laminaria hyperborea, densely forested (Ft) in shallow water, thinning to park (Pk) but with a generally sparse understorey of red seaweeds and more characteristic of LhypFa
ECR.Alc	AlcSec	Rock faces and steep exposed rock features of infralittoral and circalittoral zones	W1, and the deeper exposed faces of gullies in transect	Dominated by "dead men's fingers", Alcyonium digitatum and the bryozoan Securiflustra securifrons, a biotope typical of high-energy, tide and wave swept, rock faces
MCR.GzFa	FaAlC FaAlC.Abi	In areas of the infralittoral with high grazing pressure from Echinus esculentus	At W2 in areas where the faunal turf is sparse	Typified by sparse faunal and algal crusts and the urchin Echinus esculentus, often with sparse A. digitatum and some grazing tolerant fauna
MCR.Bri	Oph	In mixed sediments of the overlying veneer and on mixed sediments at the boundary of the offshore sublittoral sediment	W7, and W5 on boulder cover over sand	Simply brittlestar beds, characterised by Ophiothrix fragilis and/or Ophiocomina nigra but not limited to these. Very obvious in video and still photographs from the dive surveys, and in association with the starfish Luidia ciliaris.
MCR.ByH	Flu Flu.Flu	The dominant biotope of the rock surfaces of the circalittoral zone	W2, W3, and W4, and MNCR Survey No. 449.	Dominated usually by the bryozoan Flustra foliacea, though other bryozoan and hydrozoan species occur. Generally associated with the surfaces of scoured rock and mixed substrates.
MCR	Urt.Urt	In mixed sediments at the boundary of the exposed rock and offshore sublittoral sediment	W6 adjacent to boulder and stone cover	Typical of sandy sediments overlying rock, this biotope is dominated by the anemone Urticina felina and is an indicator of sand scour conditions on exposed rock.
CGS/CMS	Not defined	The dominant sand cover of the offshore sublittoral zone	At W3, W4, W5, and W6 this is the dominant biotope	Extensive areas of sand beyond the 47 m isobath. The biological community is not characterised, though core samples were taken at these dive sites.

The Littoral Zone

The littoral zone in the region of Billia Croo can be characterised as an exposed environment, comprising a boulder beach, flanked to the south by a rocky promontory and to the north by steeply shelving bedrock leading to a cliff coastline. Quantitative surveys have been carried out on the rocky areas to the north and south of the boulder beach, which noted the general pattern of seaweed and animal colonisation. The boulder beach was surveyed in a qualitative manner, as the dominant boulder substratum made quantitative quadrat work difficult. In addition, a

detailed species list for the area will be completed for the Billia Croo shore in July 2002.

Bedrock promontory
The rocky promontory to the south of the boulder beach comprises a patchwork seaweed community. The moderate abundance of seaweed suggests that the littoral zone in this area is subject to moderate wave exposure. The topography of the promontory (its height varies by several meters) is such that some wave action is likely to be absorbed, giving the opportunity for seaweed colonisation.

Species characteristics of extreme wave exposure are found, however, in the exposed area that marks the transition between the littoral zone and the sublittoral fringe. These include *Alaria esculenta* (EIR.KFaR.Ala.Ldig) with abundant *Himanthalia elongata* (ELR.FR.Him). These dominant algae shelter a variety of smaller foliose and filamentous red and green species.

Mussel (*Mytilus edulis*) beds, composed of very small individuals, are also common at the low water mark, in a patchwork pattern. Mussels are also abundant in the mid-littoral zone, and along with frequent patches of fucoid growth, dominate this area (MLR.MF. MytFves), with *Fucus vesiculosis* on exposed rock, and *F. serratus* in rockpools. Barnacle species become common in the mid-littoral area. Other mid-littoral communities exist in rockpools (LR.Rkp.Cor, LR.Rkp.FK) and on raised platforms in the bedrock (ELR.MB.MytB). In the upper littoral area barnacles and mussels gradually disappear to be replaced by encrusting species, e.g. *Verrucaria* sp. (LR.L.Ver.B) in the upper littoral fringe. Rockpools contain fucoids and smaller filamentous and foliose species (LR.Rkp.G).

Sparse fucoid growth is still evident in the very upper reaches of the littoral area, apparently above the *Verrucaria* zone. The area beyond this, up to the edge of the low cliff headland (approximately 10-15 m in width), is virtually uncolonised, and composed of large boulder and bedrock substrata.

Boulder beach
The boulder beach consists of a steep upper-littoral zone, which levels out through the mid- and lower-littoral/sublittoral areas. Boulders are smooth and rounded, varying between 0.5 and 2 m in size. The combined width of the littoral zone is less than that of the rocky promontory to the south and the nature of the beach suggests that its exposure to waves might be greater.

Although not immediately apparent, there is a fairly abundant presence of plants and animals in the mid to lower reaches of the littoral zone, especially in the spaces between boulders, suggesting their size may provide a degree of shelter for some species. Near the low water mark *Laminaria digitata* is observed in the shallow sublittoral. Species indicative of wave-exposure, e.g. *A. esculenta* and *H. elongata*, are present infrequently or only as drift. Boulder tops are frequently decked with algae, including *F. serratus, Palmaria palmata* and particularly dense mats of *Laurencia pinnatifida* (MLR.BF.Fser.Fser.Bo; MLR.R.Pal, MLR.R.Osm). A wide variety of smaller algae are found in the spaces between the boulders, including *Cladophora sp, Mastocarpus stellatus* and *Chondrus crispus*. Various whelk species were also abundant here.

This trend continues into the mid-littoral area, where fucoids are still quite abundant in patches hanging off the sides of boulders. Limpets are common with only a sparse barnacle presence (MLR.BF.FvesB). Fucoids persist into the upper-littoral area along with *Verrucaria* sp (LR.L.Ver.B).

Bedrock shelf
The area of shelving bedrock which was surveyed lies immediately adjacent to the "Naming Stone", a well-known feature of local heritage located to the north of the boulder beach (see Section 9). The area surveyed comprises a section on sloping bedrock at the base of a low cliff, the narrowest littoral area of the three sites. It is apparent that wave exposure at this site is higher, given the much greater depth of the adjacent sub-littoral zone. This is illustrated by the presence of wave-tolerant species, e.g. *A. esculenta* and *H. elongata*, among colonies of small, densely packed, *M. edulis* (EIR.KfaR.Ala.Myt; ELR.FR.Him). Mussels remain abundant in the mid-littoral (ELR.MB.MytB). The two species of algae disappear within a short distance, and are replaced by a fucoid species, possibly *F. vesiculosis var linearis*, which is characteristic of high wave exposure (ELR.MB.BPat.Fvesl). *Porphyra sp.* and *P. palmata* also become common in this zone and barnacles are very abundant here as well. The remaining two-thirds of the transect is largely bare bedrock, with mats of green algae (*Enteromorpha* sp.*, Blidingia* sp.) present in places, indicating a freshwater discharge (probably from the cliff above), and patches of *Verrucaria* sp. in the upper littoral reaches (MLR.Eph.Ent; LR.L.Ver.Ver).

Although not appearing in the transect survey at this site, the presence of the fucoid, *Fucus distichus subsp.anceps.* is noteworthy (ELR.FR.Fdis). Its occurrence in Orkney is at the extreme south of its range. Whereas other species such as *A. esculenta* and *H. elongata* may exist under several degrees of exposure, *F. distichus* only ever occurs under a very high degree of wave action. Given the, albeit slim, possibility of an alteration to the wave regime as a result of the placement of offshore wave devices, the indicator value of this species provides a suitable sentinel for ongoing survey and monitoring to observe possible changes in its distribution. The detailed species list to be completed in July 2002 will provide a detailed account of its present distribution at Billia Croo.

Table 4.2
Detailed classification of the patchwork of littoral biotopes of the shore at Billia Croo

HIGHER CODE (CONNER ET AL., 1997)	BIOTOPE CODE (CONNER ET AL., 1997)	ZONES WHERE FOUND	SHORE SURVEY SITES	DESCRIPTION - FOR FURTHER DETAIL AND UK EXEMPLAR PHOTOGRAPHS SEE WWW.JNCC.GOV.UK/MERMAID/BIOT_FRAMES.HTM
EIR.KfaR	Ala.Ldig Ala.Myt	Immediately adjacent to LW fringing the infralittoral zone	Bedrock promontory and bedrock shelf	Dominated by the kelp Alaria esculenta, with Laminaria digitata on exposed sublittoral fringe bedrock promontory, and with Mytilis edulis on the bedrock shelf
ELR.FR	Him F.dist	Lower littoral fringing LW	Bedrock promontory and bedrock shelf	Dominated by dense thongs of Himanthalia elongata; or for Fucus distichus the fucoid, Fucus distichus rarely found in the UK and only under conditions of extreme wave exposure.
ELR.MB	MytB Bpat.Fvesl	Exposed eulittoral rock	Bedrock shelf	Exposed rock surfaces dominated by mussels (Mytilis edulis) with barnacles; and barnacles with limpets (Patella spp.) and Fucus vesiculosus f. linearis
MLR.MF	MytFves	Mid-littoral	Bedrock promontory	In the mid eulittoral, the mussels form a band or large patches with scattered bladder wrack Fucus vesiculosus.
MLR.R	Pal Osm	Mostly on the boulder tops in the mid to low littoral zones	Boulder beach	Moderately exposed lower eulittoral rock supporting stands of dulse Palmaria palmata; or other redseaweeds where Osmundea (Laurencia) and/or Gelidium

				always dominate.
MLR.BF	FvesB Fser.Fser.Bo	Mid-littoral	Boulder beach	Barnacle and fucoid dominated shore zones charactersied by Fucus vesiculosus and Fucus serratus
MLR.Eph	Ent	Upper littoral	Bedrock shelf	Characterised by Enteromorpha spp. On the upper shore generally and often associated with fresh water run-off.
LR.Rkp	Cor Fk G	Rock pools	Bedrock promontory	A number of rockpool biotopes, dense coralline algal crusts (Cor), fucoids and kelps in deep eulittoral pools (Fk) and green algae in pools usually higher up the shore (G)
LR.L	Ver.B Ver.Ver	Upper littoral fringe	Bedrock promontory and boulder beach	Dominated by the lichen Verrucaria maura, occurring with barnacles on the rock promontory

4.2.3. Mammals, fish and birds

A number of cetaceans are known to occur in this area (and more generally throughout the western coasts of Orkney). Data provided by the local cetacean recorder indicate the harbour porpoise (*Phocoena phocoena*) will be present in the area off the west coast of the Orkney Mainland and are known to feed in the area from April to September. This species is Orkney's most commonly observed cetacean. There have also been regular sightings of minke whales (*Balaenoptera acutorostrata*) and Risso's dolphin (*Grampus griseus*) and occasional sightings of the white beaked dolphin (*Lagenorhynchus albirostris*). Some sightings further offshore suggest the occasional presence of white-sided dolphins (*L. acutus*) killer whales (*Orcinus orca*) and pilot whales (*Globicephala malaena*). There are no resident cetacean populations in this area.

Seals are observed in the area with the nearest known haul-out being recorded as Warebeth beach where sightings of up to 50 individuals have been reported.

The fish fauna is poorly investigated for this part of Orkney, but includes species generally resident in exposed Orkney coastal waters in association with bedrock seabed communities. These include saithe (*Pollachius virens*), pollack (*Pollachius pollachius*) and ling (*Molva molva*). Other gadoids appear more seasonally with cod, (*Gadus morhua*) being found more often in the summer months, whiting (*Merlangius merlangus*), and haddock (*Melanogrammus aeglefinus*), which tends to appear in larger, but often quite variable numbers, in coastal waters in late summer and autumn months.

The herring (*Clupea harengus*) and mackerel (*Scomber scombrus*) are also present in these coastal waters from time to time, but generally only briefly in large numbers during their migratory passage past the Orkney archipelago.

Monkfish (angler) (*Lophius piscatorius*) spawn in deep water along the edge of the continental shelf edge, mainly in March and June but juveniles and non spawning adults are present throughout Orkney waters. Other exploited demersal species of minor importance include conger eel (*Conger conger*) and gurnards (*Triglidae* sp).

The rocky and boulder covered substrates of the inner coastal seabed provide habitats well suited to lobster (*Homarus gammarus*), the brown crab (*Cancer pagurus*), velvet crab (*Necora puber*) and the crawfish (*Palinurus elephas*).

Diadromous fish (i.e. spend part of their lives in fresh water and part at sea) species present in Orkney waters include Atlantic salmon (*Salmo salar*), sea trout (*Salmo trutta*) and eel (*Anguilla anguilla*). There are no large rivers in Orkney where salmon can spawn therefore this species is not as abundant as others Scottish coastal areas. However sea lochs, burns and the coastal waters of Orkney are known to support populations of sea trout. No important spawning burns are located in the vicinity of the proposed wave test site.

Refer to Section 14 - Under Sea Photographs 4.1 - 42

The nearby clifftop habitats provide important nesting areas for many species of bird. However, the RSPB have confirmed that there are no populations of nationally or internationally important species (see Section 5 - Onshore Ecology).

4.3. Potential Impacts

The cable laying and deployment of anchors and moorings for device trials will cause only temporary and minor disturbance to seabed habitats, which by their very nature are subject to high-energy disturbance and scour.

The crossing of the shore by the cable will require the lifting of boulders to form a trench across the boulder beach. This is a highly mobile shore (despite the size of many of the boulders) and such disturbance will be temporary, extremely localised with relatively rapid recovery of the overlying algal assemblages expected and re-colonisation by the faunal community. While continual movement of boulders may result in portions of the armoured cable being exposed (a feature of many cable landfalls on similar shores in Orkney) it is anticipated that this activity will result in less environmental disturbance overall than the alternative of drilling through the littoral and surf zones. This is particularly evident in terms of noise, disturbance to shore birds, and the levels of traffic to the site at Billia Croo.

The operation of devices on test will result in the removal of energy, which in principle may affect adjacent marine biotopes characteristic of high wave energy exposure. It is hypothesised that on the scale of trials envisaged no alteration to sub-littoral seabed communities will be observable, with any effects, if at all, being limited to littoral biotopes. The presence of *Fucus distichus subsp. anceps* provides a useful sentinel species on the shore, which can be simply and cheaply monitored.

The noise from device operation is likely to be device specific, but based on the known general mechanisms that the test devices will comprise, it is expected noise will be generally of a low power level in terms of sound intensity and also of low frequency. It is likely that individual devices will have their own sound signatures, however the extent to which these will be discernible against background noise at any distance from them is not known. Despite the scarcity of data it can still be concluded that the sound levels produced from the wave test devices will be small compared with those from other anthropogenic sources (e.g. shipping) or compared to background ‘sea’ noise levels, particularly in this area which is known to experience severe sea state regularly.

Result of recent work investigating potential effects of noise from offshore wind farms on marine wildlife (Vella *et al*, 2001) can be used to provide an indication of the likely impacts from wave test devices. This work concluded that although again there was a scarcity of data noise generated by offshore wind turbines falls within the lower range of frequency in source pressure spectrum for anthropogenic noise and ‘ocean’ noise and outside the ‘behavioural reaction’ sensitivities of most marine species (e.g.

seals and small cetaceans). Some avoidance behaviour maybe apparent in fish species, (e.g. cod) in the close vicinity of the devices. However the presence of other objects in the sea (e.g. oil and gas platforms and pipelines) has been demonstrated to act as artificial reefs where fish tend to aggregate.

Any hydro-acoustic signals from underwater cables are not detectable by divers, even at very close range. It is concluded that underwater noise from the cable will not be a source of environmental disturbance to cetaceans, pinnipeds or fish.

It is considered that the physical presence of the devices will lead to interaction with offshore birds and marine mammals in a similar mode to that seen with buoys, vessels or other floating structures. Devices may serve as a local attraction, and provide a temporary, though perhaps rather less stable, roost or haul-out than a ship or buoy. Based on known behavioural patterns of seals it is expected they will soon habituate to the presence of the devices and avoid situations which may potentially harm them (e.g. avoidance of moving parts etc) (Duck, pers comm.).

It is expected that the test devices, cables and seabed moorings will be rapidly colonised by species characteristic of the hard substrate habitats in the area. Marine growth including seaweeds, barnacles and other invertebrates, could be expected to occur on test devices. If fouling has implications on the performance of specific devices it could be that antifouling paints may be required to be used on devices. TBT based paints are now banned however the properties of any such paints will need to be assessed on an individual device basis. There may be requirements to periodically remove any growth as part of routine maintenance. It is expected that this will be undertaken using mechanical methods (e.g. water jet).

At the time decommissioning, consideration will need to be given to the potential impacts from the removal of these structures versus the option to leave them in place due to the local habitat they have created. This will need to be balanced with other potential impacts e.g. on other sea users.

4.4. Mitigation Measures

During the installation phase of the project it will be important that disturbance to the shore and seabed habitats is contained within as small an area as possible. This can be achieved through general good civil engineering practices.

Due to the limited knowledge on certain potential impacts arising from the presence of test devices, it is recommended that further research be encouraged. In particular in relation to:

- Impacts on shoreline ecology from the removal of energy from the marine environment. The presence of *Fucus distichus subsp. anceps*. provides a useful sentinel species on the shore, which can be simply and cheaply monitored.

- Characterisation of background noise prior to device installation and an attempt to determine the zones over which device sound signatures may be detectable.

The presence of the CCTV cameras at the coastguard lookout will enable any significant effects on general marine life and ecology to be observed, and more

generally will provide data of interest to SMRU, the Orkney Field Club, local recorders and the Orkney Whale and Dolphin Group.

At the time of decommissioning, a BPEO study (best practicable environmental option) should be undertaken to fully investigate the impacts associated with different decommissioning options.

4.5. Residual impacts

It is considered that the chosen installation method for the offshore cables, i.e. across the boulder shore, represents the Best Practical Environmental Option for installation.

In terms of the potential impacts from the presence of test devices, there has been little research to date on potential specific impacts however as part of the remit of the Marine Energy Test Centre it is important that studies into potential impacts are established. Such data will be important to developers in order to support future applications for the development of larger scale commercial offshore projects.

5. Onshore Ecology

5.1. Introduction

The onshore elements of the Marine Energy Test Centre comprise:

- Construction of an underground switchgear building behind the shore at Billia Croo;
- Upgrading of an existing track from the public road to the switchgear building; and
- Installation of underground electrical and communication cables between the switchgear building and the public road and the Black Craig coastal lookout building which will be upgraded to house CCTV cameras.

The environmental assessment, in this section of the report, has therefore addressed the potential impact that this construction and the ongoing operation of the facility may have on the onshore ecology of the area.

The installation of the overhead power cables from the public road to the main control centre in Stromness is the subject of separate consideration by Scottish and Southern Energy and therefore the potential impacts of this on the onshore ecology has not been considered here. The main control centre in Stromness will utilise existing office space in the Old Academy, Stromness. There will be no impact on onshore ecology from the use of this facility.

Several data sources have been used to compile data on the onshore ecology of the area around Billia Croo for the environmental assessment:

- Data from Scottish Natural Heritage (SNH) on the botanical interests of the Stromness Heaths and Coast Site of Special Scientific Interest (SSSI) and candidate Special Area of Conservation (cSAC); and
- Records held with the Orkney Biological Records Centre (OBRC); and
- Royal Society for the Protection of Birds (RSPB).

In addition to records from previous surveys of the area, a Phase 1 habitat survey was undertaken as part of the environmental assessment over a week in June 2002. This survey was undertaken in line with JNCC guidelines (JNCC, 1993). The survey was undertaken at two levels:

- A broad sweep habitat survey of the wider area which identified the main habitats present; and
- A more detailed survey of the areas directly impacted by construction or preparation of the Marine Energy Test Centre (i.e. construction of the underground building behind shore at Billia Croo and installation of underground cables).

5.2. Existing Conditions

The construction of the facilities associated with the establishment of the Marine Energy Test Centre will take place in the coastal area behind Billia Croo (see Section 16 - Drawing no. 1543/50). The upgraded track and switchgear building will be located on agricultural land, out with the Stromness Heaths and Coast SSSI and cSAC. The Coastguard lookout at Black Craig, which will be made secure to house CCTV cameras, is located within the Stromness Heaths and Coast SSSI and cSAC, at the southern extreme of the coastal grassland and heathland area (see Appendix F, Figure 5.1). The designated conservation area south of Black Craig is recognised for is geological and geomorphological rather than botanical interests.

5.2.1. Switchgear building, upgraded track and underground cables

Agricultural land is the dominant habitat type in the area with the majority used for silage, hay or rough grazing. These areas are defined and illustrated in Appendix F, Figure 5.1. The majority of the grassland in the area can be classed as semi-improved. This is defined as grassland that has been modified by artificial fertilisers, slurry, grazing, herbicides or drainage and has a range of species, which is less diverse and natural than unimproved grasslands (JNCC, 1993).

The switchgear building, track proposed for upgrade and underground cables to the public road and Black Craig will be constructed through semi improved grassland used for rough grazing. There is a small area of marshy grassland to the north of the track (OS reference 3225 10105). Species sampled in this area during the June 2002 survey included common cotton grass (*Eriporum angustifolium*) and horses tail (*Equiestum spp*).

A small stream lies adjacent to the proposed switchgear building. Species sampled in this area include sedges, large stands of yellow iris (*Iris pseudacarus*) and thistles (as illustrated in Appendix F, Figure 5.1). Other streams present in the area tend to be seasonal in nature with little water present during the drier summer months. These streams were noted as dry in the June 2002 survey.

None of the species recorded in this area during the survey are considered to be scarce or threatened.

5.2.2. Underground cable to Black Craig lookout

A small proportion (approximately 260 m) of the proposed route for the underground cable to the Black Craig lookout is located within the Stromness Heaths and Coast

SSSI and cSAC, at the southern extreme of the coastal grassland and heathland area. The total area of the designated site is 755 hectares.

The designation of the SSSI is due to its prime example of coastal vegetation communities and associated breeding birds in addition to its interesting geological and geomorphological features (see Section 8). The major botanical feature of the site is the juxtaposition of different coastal habitats and the natural landward transition from typical maritime communities to a heathland community interspersed with species rich flush and mire communities. Some of the habitats present are considered to be rare or threatened within a European context and as such designated within the cSAC. These include European dry heaths, vegetated sea cliffs of the Atlantic and Baltic coasts and alkaline fens.

The coastal cliff-top communities are strongly influenced by the sea and in this area species such as sea plantain (*Plantago maritima*) and thrift (*Armeria maritima*) are co-dominant. Cliff top communities grade into coastal heath and grassland away from the coast. Coastal heath is often rich in species and dominated by dwarf shrubs such as heather (*Calluna vulgaris*), crowberry (*Empetrum nigrum*) and bell heather (*Erica cinerea*). Creeping willow (*Salix repens*) is scattered throughout the heath and other associated species include mountain everlasting (*Antennaria dioica*) and wild thyme (*Thymus praecox*).

The coastal grassland includes herb-rich sedge dominated vegetation. Species such as spring squill (*Scilla verna*) and two species of plantain (*Plantago maritima* and *P. coronopus*). The UK scarce Scottish primrose (*Primula scotica*) thrives locally in this coastal heathland and grassland.

Records of plant species found around the Black Craig area have been provided by the OBRC and a list of all species recorded provided in Table 5.1. Of the species recorded, three are classed as British scarce species, Juniper, small adders tongue and *Primula scotica*. Juniper is also on the threatened plants database.

Species sampled during the June 2002 habitats survey along the proposed cable route included heather (*Calluna vulgaris*), spotted orchids (*Dactylorhiza spp*), slender St. John's-wort (*Hypericum pulchrum*), purging flax (*Linum catharticum*), birdsfoot trefoil (*Lotus corniculatus*), lousewort (*Pedicularis sylvatica*), common dog violet (*Viola riviniana*) and common cottongrass (*Eriporum angustifolium*) (see Appendix F, Figure 5.1).

Table 5.1
Plant species recorded in the general area around Black Craig (SSSI and non SSSI land) (Source: Orkney Biological Records Centre)

BRITISH SCARCE SPECIES *JUNIPERUS COMMUNIS SSP ALPINA,* JUNIPER *OPHIOGLOSSUM AZORICUM,* SMALL ADDER'S-TONGUE *PRIMULA SCOTICA,* SCOTTISH PRIMROSE NOTE: JUNIPER ALSO ON THE THREATEN PLANTS DATABASE. OTHER SPECIES *AGROSTIS CANINA,* VELVET BENT *AGROSTIS CAPILLARIS,* COMMON BENT *AGROSTIS STOLONIFERA,* CREEPING BENT *ANTENNARIA DIOICA,* CAT'S-FOOT, MOUNTAIN EVERLASTING *ANTHOXANTHUM ODORATUM,* SWEET VERNAL-GRASS *ARMERIA MARITIMA,* THRIFT, SEA-PINK *BELLIS PERENNIS,* DAISY *CALLUNA VULGARIS,* HEATHER, LING *CAREX BINERVIS,* GREEN-RIBBED SEDGE *CAREX DIOICA,* DIOECIOUS SEDGE *CAREX ECHINATA,* STAR SEDGE *CAREX FLACCA,* GLAUCOUS SEDGE *CAREX NIGRA,* COMMON SEDGE *CAREX PANICEA,* CARNATION SEDGE *CAREX PULICARIS*, FLEA SEDGE *CAREX VIRIDULA SSP. BRACHYRRHYNCHA,* LONG-STALKED YELLOW-SEDGE *CAREX VIRIDULA SSP. OEDOCARPA,* YELLOW SEDGE *CERASTIUM DIFFUSUM,* SEA MOUSE-EAR CHICKWEED *CERASTIUM FONTANUM SSP VULGARE,* COMMON MOUSE-EAR CHICKWEED *CIRSIUM PALUSTRE,* MARSH THISTLE *COCHLEARIA OFFICINALIS,* SCURVEY-GRASS *DACTYLORHIZA MACULATA SSP ERICETORUM,* MOORLAND SPOTTED ORCHID *DACTYLORHIZA PURPURELLA,* NORTHERN FEN ORCHID *DANTHONIA DECUMBENS,* HEATH GRASS *DESCHAMPSIA CESPITOSA,* TUFTED HAIR-GRASS *EMPETRUM NIGRUM SSP NIGRUM,* CROWBERRY *ERICA CINEREA,* BELL HEATHER *ERIOPHORUM ANGUSTIFOLIUM,* COMMON COTTONGRASS *EUPHRASIA AGG.,* EYEBRIGHT *FESTUCA RUBRA AGG.,* RED FESCUE *FESTUCA VIVIPARA,* VIVIPAROUS FESCUE	*GLAUX MARITIMA,* SEA MILKWORT *HOLCUS LANATUS,* YORKSHIRE FOG PUNDS *HYPERICUM PULCHRUM,* SLENDER ST JOHN'S-WORT *HYPOCHAERIS RADICATA*, CAT'S-EAR *JUNCUS CONGLOMERATUS*, COMPACT RUSH *JUNCUS EFFUSUS*, SOFT RUSH *JUNCUS SQUARROSUS,* HEATH RUSH *LEONTODON AUTUMNALIS,* AUTUMNAL HAWKBIT *LINUM CATHARTICUM,* PURGING FLAX *LOTUS CORNICULATUS,* BIRD'S-FOOT TREFOIL *LUZULA CAMPESTRIS,* FIELD WOODRUSH *LUZULA MULTIFLORA*, HEATH WOODRUSH *MOLINIA CAERULEA,* PURPLE MOOR-GRASS *NARDUS STRICTA*, MAT GRASS *NARTHECIUM OSSIFRAGUM,* BOG ASPHODEL *PARNASSIA PALUSTRIS,* GRASS-OF-PARNASSUS *PEDICULARIS PALUSTRIS,* RED RATTLE *PEDICULARIS SYLVATICA,* LOUSEWORT *PLANTAGO CORONOPUS,* BUCK'S-HORN PLANTAIN *PLANTAGO LANCEOLATA,* RIBWORT *PLANTAGO MARITIMA,* SEA PLANTAIN *POA HUMILIS,* SPREADING MEADOW-GRASS *POA PRATENSIS*, SMOOTH MEADOW-GRASS *POA TRIVIALIS,* ROUGH MEADOW-GRASS *POTENTILLA ANSERINA,* SILVERWEED *POTENTILLA ERECTA,* TORMENTIL, HILL-BARK *PRUNELLA VULGARIS,* SELF-HEAL *RANUNCULUS ACRIS,* MEADOW BUTTERCUP *RHINANTHUS MINOR AGG.,* YELLOW RATTLE *RUMEX ACETOSA,* SORREL *RUMEX ACETOSELLA,* SHEEP'S SORREL *SAGINA PROCUMBENS,* PROCUMBENT PEARLWORT *SALIX REPENS VAR. ARGENTEA,* SILVER CREEPING WILLOW *SCILLA VERNA,* SPRING SQUILL *SUCCISA PRATENSIS,* DEVIL'S-BIT SCABIOUS *THYMUS POLYTRICHUS,* WILD THYME *TRICHOPHORUM CESPITOSUM,* DEER-

	GRASS *TRIFOLIUM REPENS,* WHITE CLOVER *VACCINIUM MYRTILLUS*, BLAEBERRY *VERONICA OFFICINALIS,* COMMON SPEEDWELL *VIOLA CANINA,* HEATH DOG VIOLET *VIOLA RIVINIANA,* COMMON DOG-VIOLET

The Stromness Heaths and Coast SSSI and cSAC supports small numbers or Arctic and great skua, but these species are not present in internationally important numbers and other sites in Orkney can be considered to be more important for these species e.g. North Hoy, Rousay, Eday and Papa Westray.
These species can be expected to be present nesting in heathland areas, including that around Black Craig during the late spring and summer months. However, greatest numbers of nesting birds would be expected in the more extensive heathland areas to the north of Black Craig.

No other terrestrial species of conservation importance are known to be present along the stretch of the Orkney West Mainland coast.

5.3. Potential impacts

The upgraded track and adjacent underground cables pass through semi improved grassland habitat that is not considered to be of significant conservation importance. The upgraded track will be approximately 3.0 m wide and comprise hard core only. It is therefore expected that following the construction period the track will only receive occasional use and soon become overgrown with the surrounding vegetation.

The proposed switchgear building is located immediately adjacent to a small stream. The presence of the new building will not influence the drainage of this stream. The temporary lay down area required during the construction phase will also be located away from the stream. The earthworks around the building have been designed to reinstate the natural landform as much as possible, with the soil and rock excavated for the new switchgear building, re-used around and over the buried structure, consequently no spoil will be required to be removed from the site.

Although scarce and threatened plant species have been recorded in the vicinity of Black Craig, (on both SSSI and non SSSI land), none were recorded along the proposed cable route during a habitat survey conducted in June 2002. However, a precautionary approach will be adopted to minimise any disturbance to the vegetation in the Black Craig area (see mitigation measures). The electrical and communication cables that will be installed to the old coastguard's building at Black Craig will only be small diameter cables and will be buried in a narrow trench at relatively shallow depth (approximately 300mm wide by 400mm deep). The installation of these cables will therefore not require the use of large-scale excavation equipment, which would cause greater damage to sensitive areas.

Approximately 250m length of the cable route will pass through of the Stromness Heaths and Coast SSSI and cSAC. Assuming that the installation of the cable will impact an area of approximately 5m width, then the overall area impacted during installation will be 1,250 m^2. The overall area of the SSSI and cSAC is 7.55 km^2 (755 hectares) therefore the potentially disturbed areas will be less than 0.02% of the overall SSSI and cSAC area.

During the operational phase of the Marine Energy Test Centre it is likely that there will be increased local and tourist interest in this area to the west of Stromness. This may lead to increased numbers of people walking along the shore at Billia Croo and Black Craig, and damage to vegetation in this area.

Once the centre is operational there will be no routine vehicular access required to the Coastguard's lookout building at Black Craig.

The installation of the off shore generation devices may generate significant numbers of walkers to the Coastguard's lookout building at Black Craig, which will overlook the device mooring area.

5.4. Mitigation measures

The temporary lay down area and construction of the switchgear building will be located away from, and therefore avoid disturbance to the stream immediately to the south of the building site. As stated above, the engineering design has been carried out to minimise the quantities of imported fill material and the material excavated on the site will be reused to infill and landscape around the new building.

The proposed construction period for the Marine Energy Test Centre facilities is between October 2002 and September 2003. As the installation of the cable to the Black Craig is not a critical element on which other activities are dependent, there is flexibility with the timing of installation. In order to ensure any impacts on plants and breeding birds is minimised the exact timing of these installation activities will be agreed in consultation with the RSPB and SNH/Orkney Field Club.

Consultation with SNH has indicated that specific measures will be required to minimise the damage to the existing turf - carefully lifting and relaying the turf during the trenching works will achieve this. In addition small tracked equipment will be used to install this cable to ensure that any vegetation damage in the vicinity of the trench is minimised. Vehicles utilised during installation activities will not be allowed to stray out with the immediate vicinity of the cable route.

If the number of walkers to Black Craig Hill increases significantly once the off shore devices are installed then, in order to minimise the extent of land walked over, it will be necessary to agree and define, in conjunction with the local landowners, SNH and other relevant stakeholders e.g. Orkney Field Club, a preferred walking route, which can then be publicised.

5.5. Residual impacts

It is considered that if the above management and mitigation measures are implemented, there will be no residual impact on the onshore ecology of the area during the construction phase of the project. Any minor damage to vegetation in the Stromness Heaths and Coasts SSSI and cSAC will not be long term. In addition, any vegetation disturbance during cable installation will only occur in a very small area of the overall designated conservation area.

Depending on the amount of public interest in the off shore devices, there is the potential for increased public presence within the SSSI and cSAC at Black Craig.

6. Landuse, Fisheries and Socio-economic Issues

6.1. Introduction

The establishment of a new facility in any rural area has the potential to affect the local population in both a positive and negative manner. The proposed Marine Energy Test Centre comprises both offshore and onshore facilities and this section of the Environmental Statement addresses the socio-economic issues associated with their construction and operation. The issues associated with the offshore facilities are generally different from those associated with the onshore aspects of the project and therefore have been dealt with in separate sub sections.

Consultation with relevant local and other stakeholders was undertaken as part of the environmental assessment. This together with specialist local knowledge has provided important input to this aspect of the environmental assessment.

The overall concept of the Marine Energy Test Centre was presented to local stakeholders at a meeting of the Orkney Marine and Coastal Study Forum at which opportunity was provided for any concerns to be raised. In addition discussions were held with the following organisations:

- Orkney Islands Council, Department of Harbours;
- Orkney Dive Boat Operators Association;
- Orkney Fisheries Association;
- Orkney Fishermen's Society;
- Orkney Islands Sea Angling Association;
- SNH;
- SEPA;

Responses and notes of meetings with these organisations are included in Appendix D, for information.

6.2. Local economic benefits

One issue that is common to both offshore and onshore aspects of the project is the local benefits from the establishment of such a facility in Orkney.

To date, where local expertise has been available, local companies have been employed during the design development of the project, including carrying out some of the studies required for the preparation of this document. During construction work, local companies will also be employed in the provision of specific elements of the works.

In the longer term, there are employment opportunities for a locally based company to be involved in the operation of the Marine Energy Test Centre, and there are also opportunities for local contractors to provide support services to the new facility.

In addition, there will be positive spin off benefits for the local economy. The increase in the number of personnel visiting Stromness will increase demands for accommodation and other related services e.g. catering, retail outlets etc. The presence of the centre and the promotion that can take place around it will also provide an opportunity for significant secondary business opportunities in research, design, manufacturing and maintenance.

6.3. Offshore issues

6.3.1. Sea Users

From discussions held with a local trawl operator, trawling activity is known to take place off the west coast of the Orkney mainland in water depths of over approximately 58 m (192 ft). This only takes place a few times throughout the year, and depending on the time of year would target dogfish or haddock. It should be noted that trawling activity is prohibited, under the Inshore Fishing (Scotland) Act 1984, between the months of May and September within 2 miles of the coast. Concerns are expressed by local inshore shell-fishermen, however, that illegal activity does occur.

The inshore fishery in the vicinity of Billia Croo targets lobsters in depths of approximately 33- 38 m (108-126 ft), along the edge of the rock/hard ground. Up to 7 vessels are thought to fish this area adjacent to the proposed offshore wave test site at various times in the year, although at present these fishing grounds are not thought to be very productive. Nonetheless, inshore fishing vessels also require passage through this area to more productive fishing grounds further north.

The area off Billia Croo is not an important location for recreational angling compared to other areas off the west coast of Orkney. The Orkney Islands Sea Angling Association does, however, frequently pass this way on route to more rewarding fishing areas near Marwick Head. Similarly, the Orkney Dive Boat Operator's Association does not conduct any recreational diving in this area, however, they do pass through it on route to more established diving locations further north. Again, members of the Stromness Sailing Club and other yachtsmen, particularly on route between Stromness and Eynhallow Sound, will pass through the area.

The proposed offshore test area is located within a charted area to be avoided (ATBA), i.e. an area to be avoided by vessels > 5,000 grt with oil or other hazardous cargoes in bulk.

Based on the knowledge gained during the preparation of this environmental assessment, it is estimated that in excess of 20 vessels use or pass through the area proposed for testing the wave energy devices. Although there is no firm data available on the frequency that individual vessels may be present in the area.

6.3.2. Potential Impacts

Harbour Congestion

It is anticipated that during the course of the proposed development, there will be an increased presence of marine traffic in Stromness and other areas and harbours of Scapa Flow. The main off shore construction/installation activities include laying the underwater cabling from Billia Croo to the mooring locations for the off shore test devices. Underwater anchorages will also be require to be provided by the device developers, prior to their devices being installed on site. Also, once test devices have been installed on site, there will be a requirement for vessels to provide ongoing inspection and maintenance.

During consultations with OIC Harbours, they noted that at the present time, pier space within Stromness is at a premium, and consequently only available for short periods of time within which it may be possible to on and offload devices/equipment.

Whilst this is unlikely to cause a problem with the vessels carrying out the construction and future maintenance work, it would not be possible for the testing devices to be moored in the Stromness harbour area, should this be required. However, they noted that other suitable local facilities existed, such as Lyness Harbour, which could provide a sheltered mooring, or the boatyard at Burray, which could provide a facility where maintenance work could be carried out, subject to agreement with owner.

Navigation and Recreational Use
All sea users (diving, yachting, angling and fishing interests) have raised concerns regarding the possible establishment of an exclusion zone around the test devices. With most concern relating to the impact exclusion zones may have on vessel passage in the area, particularly for small boats. If small vessels are forced to navigate to the west of the devices into open sea, this may present a safety risk, particularly in adverse weather conditions.

It is currently proposed that a 500m radius exclusion zone is provided around each test device mooring location, subject to agreement with the Scottish Executive Department responsible for off shore installations. This would provide a distance of approximately 1km between the exclusion zone and the coastline, as indicated on drawing no 1543/54, in Section 16.

The possible risk of a collision between a vessel and devices located at the test site was also raised as a potential problem.

Fisheries
Both trawl fishermen and inshore shell fishermen do not believe that the test area will impact on their activities, as long as there is a navigable channel along the coast between the shore and the test area.

One issue raised by the local inshore fishermen is the possibility of loose chunks of trawl netting and other large marine debris that may affect structural integrity or performance of the devices being tested.

6.3.3. Mitigation Measures

Harbour Congestion
For the berthing requirements of the vessels carrying our the construction and installation work, programmed for summer 2003, advance liaison to be carried out between the Contractor and OIC Harbour Authority with respect to pier access.

With regard to the future berthing requirements for an inspection and maintenance vessel, a similar liaison process will be required between OIC Harbour Authority and the Marine Energy Test Centre Operating Company/Device Developers.

A number options exist within the Scapa Flow area, with regard to the potential requirement for a sheltered temporary mooring or maintenance facility for the off shore devices. Once the specific requirements for each test device are known, then a suitable plan can be developed between the Marine Energy Test Centre Operating Company/Device Developers and OIC Harbour Authority or any maintenance facility owners.

Towage Operations
For towage operations within the harbour area (i.e. to the limits of the Harbour Authority), a navigational warning must be provided to the Stromness Harbour Master.

Any towage greater than 85 m will require a pilot boat.

Navigation and Recreational Use
Subject to discussions with the navigation authorities, a 'charted passage' between the offshore test area and the shore, of at least 0.5 miles (0.8 km) in width, will be established to ensure the safe navigation of small vessels along this stretch of coast.

The test area, individual devices will all be adequately and clearly marked for safety of navigation, in accordance with the requirements of Section 34 consent procedures of the Coast Protection Act 1948.

Regarding the types of moorings employed by individual device operators, it is considered important that good dialogue is maintained between the Marine Energy Test Centre operator and those vessels/organisations that use the area for navigation.

All courses of action will be taken to inform local interests of the presence of the test area, including issue of Notice to Mariners; circulars to local sailing, angling, diving, fishing and other navigational interests; and advertisements in the Orcadian newspaper and Fishing News. The Orkney Fishermen's Society and Orkney Diver Boat Operators Association (ODBOA) has also offered its services as a vehicle for the distribution of information about the centre and it's operations to local inshore fishermen.

Regular Monitoring
Regular monitoring of the test area and test devices present, will be the responsibility of the Marine Energy Test Centre Operating Company and Device Developers, who will ensure the maintenance of navigation aids and integrity of the devices and moorings, etc.

6.3.4. Residual Impacts

The exclusion zones will be the main off shore residual impact of the new facility, however provided an adequate 'charted passage' is allowed between the offshore test area and the coast; adequate and clear markers exist for the test area and its devices (including moorings); and clear lines of communication are established and maintained with navigation interests in the area, the effects off the exclusion zones around the test devices should be minimised.

The potential risk of collision will exist, particularly in periods of adverse weather conditions, however, the exclusion areas will be adequately marked by navigation aids and the Marine Energy Test Centre Operating Company will be responsible for developing emergency contingency plans for such an occurrence.

6.4. Onshore issues

6.4.1. Existing conditions

The proposed site for the onshore facilities of the Marine Energy Test Centre is located approximately 2 miles from the town of Stromness (population approximately 1,500) in an area known as 'Outertown'. The area is serviced by a surfaced single track road which terminates at a dead end. Local residents and farmers primarily use

the road. This area of Stromness is not densely populated, although there is scattered housing and a number of small to medium sized farms.

The coastal area between Yesnaby (to the north of Billia Croo and Black Craig) and Stromness is recognised as a coastal walk/path and is popular with the local population and tourists during the summer months. Walkers on this route will pass in the immediate vicinity of the Black Craig lookout.

The main land use around Billia Croo is rough grazing on semi improved grassland (see Section 5). The land is owned by a number of different farmers. To the north beyond the agricultural land, coastal heath is the dominant land cover and much of this area falls within the Stromness Heaths and Coast SSSI (see Section 5).

6.4.2. Potential impacts

The construction phase will represent the initial increase in personnel present in Stromness as a result of the development of the Marine Energy Test Centre, however this will be minimal as wherever possible local contractors and personnel will be employed. In addition, there is likely to be increased vehicle movements on the road to Outertown during construction (see Section 10). The visual impact of the proposed facilities is considered in Section 7.

Once established, it is expected there may be an increase in visitors/tourists with an interest in the Marine Energy Test Centre. The exact increase will not be known until the centre is operational, however a similar facility at Burger Hill in Orkney used as a test area for wind turbine technology receives considerable numbers of visitors. An increase in people visiting the area will result in greater pressure on the coastal paths in the area.

Some concerns have been raised over the potential of destabilisation of household electrical supplies, however the electrical equipment has been designed so that there will be no adverse effects on the existing electrical supplies and a dedicated 11kV line will provide the electrical connection between the Switchgear building and Stromness substation.

The impacts associated with the provision of the power cables between the coastal test site facilities and Stromness is not considered within the scope of this environmental assessment. Scottish and Southern Energy will address this in the separate work associated with the installation of new overhead cables.

It can also be expected that there will be an increase in the number of people visiting as a result of the operation of the test facility. The potential positive economic impacts associated with this have been discussed above.

6.4.3. Mitigation measures

It is proposed that the main tourist/visitor interest associated with the Marine Energy Test Centre is maintained within the centre of Stromness to avoid the need to develop a visitor centre facility in Outertown. A permanent display in Stromness could provide a lot of detailed background on the project. Such a visitor facility in Stromness need not necessarily be owned and operated by the Marine Energy Test Centre operators but could be part of a wider Orkney Renewable Energy Forum (OREF) initiative.

The numbers of people visiting the Billia Croo and Black Craig area should be monitored in the early days of the operation of the centre and if numbers cause problems locally, then the provision of additional access facilities can be implemented.

For example, site visits could be more formalised and officially publicised at the Stromness visitor facility. To keep public access to the coastal area controlled and the land walked over minimised, a preferred walking route would be established in consultation with local landowners, SNH and other relevant stakeholders.

It may also be appropriate for an information board to be erected at a suitable location along the defined coastal walk displaying information on the test facility.

6.4.4. Residual impacts

The main residual issue associated with the onshore aspects of the proposed Marine Energy Test Centre is that of an increased number of people visiting the coastal area around Billia Croo and Black Craig.

7. Landscape and Visual Impact

7.1. Introduction

There are three elements of the proposed development, which will generate a visual impact. They are: -

- The proposed new switchgear building at Billia Croo and access track thereto;
- The proposed modifications to the existing old coastguard building on Black Craig Hill;
- Up to a maximum of four off shore test devices.

All the refurbishment work for the control centre, located in the Old Academy in Stromness, will be carried out within the building and will therefore cause no visual impact.

7.2. Switchgear Building at Billia Croo

7.2.1. Existing Conditions

When viewed westwards from the public road, at the foot of Black Craig Hill, the existing farmland slopes downward towards the sea. The farmland is a mixture of grazing and arable land.

Along this section of the public road, a number of farm tracks run westwards from the roadway to give access to the fields between the road and the shoreline. Some of these tracks are quite distinct being formed in hardcore, with fences on either side, whilst others are simply tractor tracks formed by regular use.

The proposed site of the new switchgear building at Billia Croo can be seen from the public road and from the local houses and farm steadings.

At Billia Croo, the shoreline curves inland to form a small bay, where, between high and low watermarks, a beach is formed from stones and rocks of various sizes. Above high water level there is a small raised beach area of generally marshy ground and landward of this feature the ground rises steeply to the existing farmland. Refer Photos 8.1, 8.2, 8.4 and 8.5 in Section 14.

7.2.2. Potential Impacts

At Billia Croo, a building approximately 15m long by 5m wide by 4m high is required to house electrical switchgear and conditioning equipment where the electrical transmission cables come ashore from the wave energy testing devices offshore. A small emergency diesel powered electrical standby generator is also required to be housed in this building, in case of supply outages. Vehicle access from the public road is required to this building.

Electrical cables will be buried in a trench across the beach, from the switchgear building, to MLWS and the location of these will require to be marked with a sign.

7.2.3. Mitigation Measures

In order to minimise the visual impact of the building, is it designed as a reinforced concrete underground structure, which will be completely buried, with the exception of a roof ventilation cowling, a handrail and part of the south facing wall, which requires to be exposed to allow access and ventilation.

It is proposed to locate the building below ground level, at the top of the steeply sloping ground above the high tide level, adjacent to an existing small stream. The location was chosen to provide the maximum height above sea level to avoid possible flooding during storms or high tides, but maintain the structure below ground level to minimise visual intrusion.

By choosing this location the surrounding ground can be reinstated to reflect it's existing form, with the exception of the area to the south of the new building where the new track and turning head is required to provide vehicular access to the building.

The access track from the end of the public road to the new building follows the route of an existing farm track, which gives access to the fields in the vicinity of the proposed new building. The existing track will be upgraded and extended by placing a layer of hardcore approximately 250mm by 3m wide on the top of the existing ground level. To avoid excavating the existing topsoil and minimise the track construction thickness a layer of geogrid reinforcement will be laid on the ground prior to depositing the hardcore. In the vicinity of the new switchgear building a new turning/parking area is proposed. In order to achieve acceptable gradients on the track in the this location, the level of the track has been raised a maximum of approximately 2m above the existing ground level, as indicated on drawing no 1543/52 in Section 16 and in the photomontages in Section 15.

The track will not be surfaced, consequently the non trafficked areas of the track will, through time, grass over and reduce it's visual impact.

It is proposed to clad the partly exposed face of the building with the indigenous grey building stone, in order to blend in as much as possible with surrounding landscape

7.2.4. Residual Impacts

The most obvious residual visual impact of the facility at Billia Croo will be the access track from the end of the public road, however as noted above, the non trafficked areas of the track will, through time, grass over and reduce it's visual impact.

Due to the way the switchgear building has been orientated and located underground, it will only be the hand railing and ventilation cowling which will be visible when viewed from the local houses, farm steadings and from the public road. The one partly exposed masonry face of the building will only be visible from the south west, i.e. from the beach or from off shore, or from the land to the south, when the viewer is close to the new building.

The beach through which the electrical cables are to be laid is reported to be very mobile, it is therefore possible that parts of the electrical cables may be exposed from time to time, depending on storm action. The sign marking the landfall of the electrical cables will also be a residual visual impact local to the shoreline.

7.3. Redundant coastguard's lookout building on Black Craig Hill

7.3.1. Existing Conditions

The existing building is approximately 4m long by 3m wide by 3m high and is situated on western side of Black Craig hill. It is a small rendered blockwork structure with a reinforced concrete flat roof that no longer used and has fallen into disrepair, such that it no longer has any windows or door and it is only the bare structure that remains – refer photos 7.1 and 7.2 in Section 14.

The building cannot be seen from the public road or from the majority of local houses as it lies on the seaward side of the hill, however it is on the route of the cliff top footpath.

7.3.2. Potential Impacts

It is proposed to install two CCTV cameras within this building to provided a visual monitoring facility for the off shore devices and, to protect the cameras it is proposed to provide a secure building envelope for the cameras by adding a lightweight galvanised steel mesh over the existing window and door openings, as indicated on drawing no 1543/55, in Section 16.

Underground cabling will be buried in a trench from the end of the public road to this building.

7.3.3. Mitigation Measures

The main mitigating measure that was adopted for this facility was the re-use of the existing building, rather than create a new one.

One additional visual benefit the of the extra care that is required in trenching for the underground cables through the SSSI / cSAC area, is that the existing turf has to be carefully lifted and re-laid, therefore there will be no visual sign of the track once the ground is reinstated.

7.3.4. Residual Impacts

A galvanised steel mesh will cover the existing window and door openings and when close to the building the CCTV cameras will be visible within the building.

7.4. Off Shore Generating Devices

The Test Centre will have the capacity for up to four generating devices to be moored off shore at the proposed locations indicated on drawing no 1543/54.

Although the specific detailed shape of these devices is not known at this stage, due to the distance off shore (approximately 1.5km/1 mile) they will appear, from the land, to be individual structures moored offshore.

8. Geology

8.1. Introduction

This description of the geology of Billia Croo has been prepared in consultation with the British Geological Survey, Scottish Natural Heritage and Dr John Flett Brown (Orkney).

The geological importance of west Mainland has attracted considerable interest since the early visits of Jameson, Trail and Miller. The first comprehensive account of the geology and glaciology by Peach and Horne, appeared in 1880. However, it was not until the period between 1927 and 1929 that the Geological Survey mapped the area. The results were integrated into 1:63,360 geological sheet 119 (Kirkwall), and the accompanying descriptive Memoir was published in 1935. The current 1:100,000 Special Provisional Map, published by British Geological Survey in 1990 provides a modern interpretation of the Devonian stratigraphy in western Mainland, largely based on late 20th century studies by Fannin and Astin.

8.2. Existing Conditions

8.2.1. Regional Setting

Geomorphology

This coast is one of the most exposed and hostile in the UK, with no recognised sheltered anchorages. Largely unprotected by offshore islands and rocks, it is exposed to high-energy Atlantic swell waves and experiences some of the highest levels of incident storm-wave energy in Britain. Because deep water extends close inshore much of the wave energy is dissipated on the coast itself.

The effect of high energy wave action on the gently inclined sedimentary rocks, that make up this part of Orkney, has been to produce a series of constantly eroding and evolving near-vertical cliffs, caves, geos, gloups, blow holes, sea stacks and extensive wave-cut wave platforms, with few sheltered bays and sandy beaches. The absence of fallen material at the base of the cliffs is testimony to the efficiency of the erosive processes.

There is a marked change in the morphology of the coast in the neighbourhood of Billia Croo. To the north, it is dominated by high cliffs, locally up to 100 m high, with no appreciable wave cut platform. Whereas to the south the topography is lower and subdued in form, with low cliffs (generally $\leq$ 15 m high) at the back of a broad wave cut platform. Inland from the shore this change is also mirrored in the varying landscape characteristics. The northern cliffs are backed by coastal hills and heath that gives way southwards to inclined coastal pasture. This change is primarily due to an overall southerly reduction in the height of the land surface, but also reflects an angular relationship between the dip direction of bedding and the fracture pattern in the sedimentary rocks with the trend of the coastline. In effect, where the rocks dip westwards towards the sea, as in the north, the potential for erosion is much greater as material readily spalls from the cliffs; hence the absence of wave cut platforms. In the south the south westerly dip of bedding is oblique to the coast, so the erosive power of the waves is lessened and an extensive wave cut platform has developed.

Solid geology

The geology of western Mainland, Orkney, is dominated by sedimentary rocks of the Middle Devonian Caithness Flagstone Group, which have a collective thickness of over 750 m. These rocks represent a sequence of fluio-lacustrine rocks deposited

along the western margin of the Orcadian Basin (Fig. 8.1), an area of active sediment deposition between late Silurian and early Carboniferous times, which extended from the Moray Firth to Shetland. The basin was partially filled with sediment derived from the erosion of the Precambrian to Lower Palaeozoic metamorphic and granitic rocks of the Caledonian Mountain belt, comparable with those exposed in small inliers at Stromness and Yesnaby.

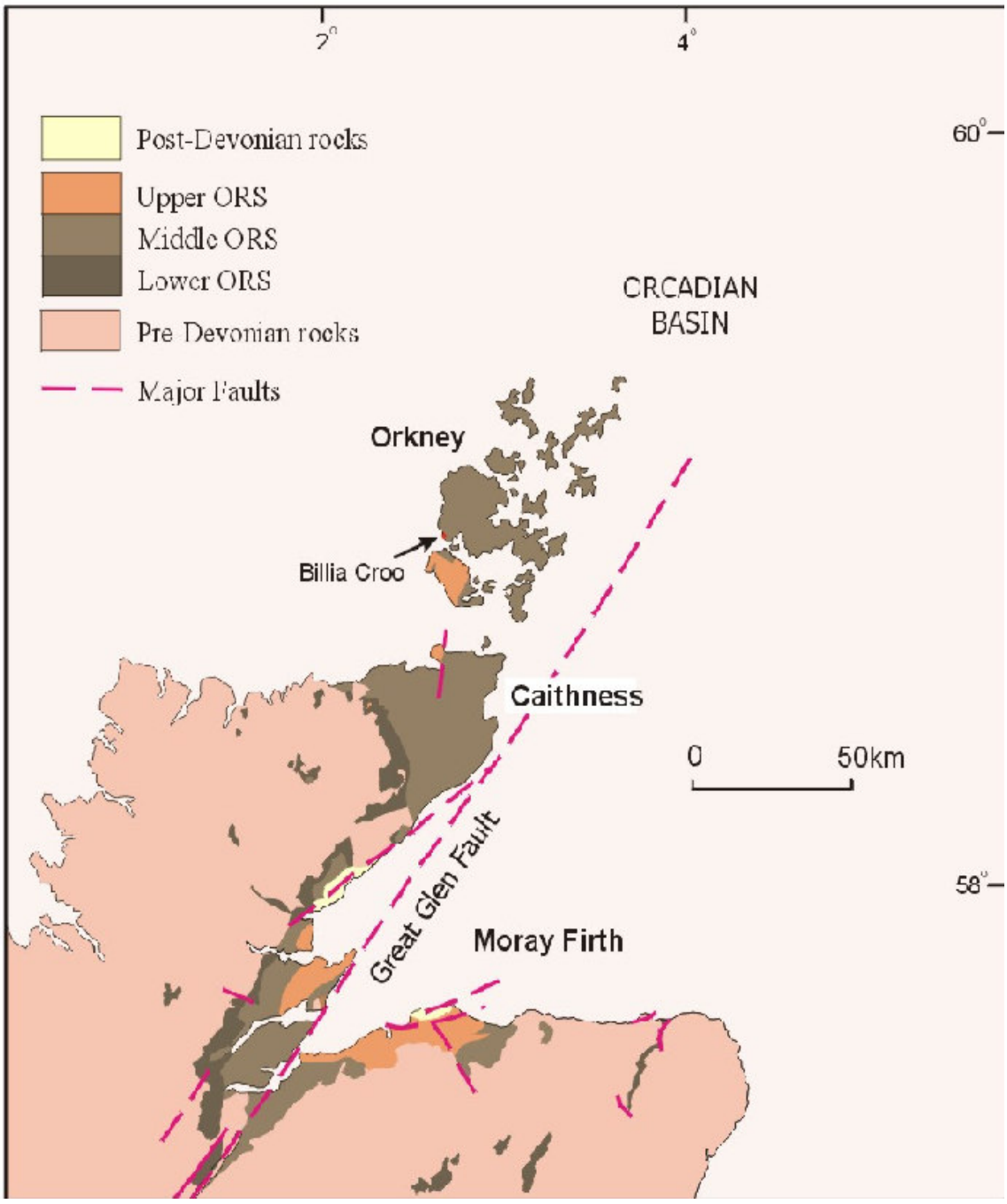

Figure 8.1

The Caithness Flagstone Group is a component of the Old Red Sandstone Supergroup (Fig. 8.2), so called because of the red-brown hue of the arenaceous alluvial fan deposits that dominate the basin margin succession in Scotland. In western Orkney the Group is separated into the Lower and Upper Stromness

Flagstone formations by the intervention of the Sandwick Fish Bed Member (Fig. 8.3), an important marker horizon that is correlated with the Achanarras Limestone Member in Caithness. Both flagstone formations comprise a succession of rhythmic or cyclic units each 5-17 m thick. They typically comprise a basal, grey, calcareous mudstone and/or dark, fossil-fish-bearing, bituminous, finely laminated limestone, successively overlain by siltstone and fine-grained sandstone capped by coarser grained sandstone. The upward coarsening of the cycles reflects a successive change in environment from perennial deep-water lake to ephemeral shallow lake with accompanying mud flats and prograding alluvial fan. Other than the fish beds the flagstone sequences are largely unfossiliferous.

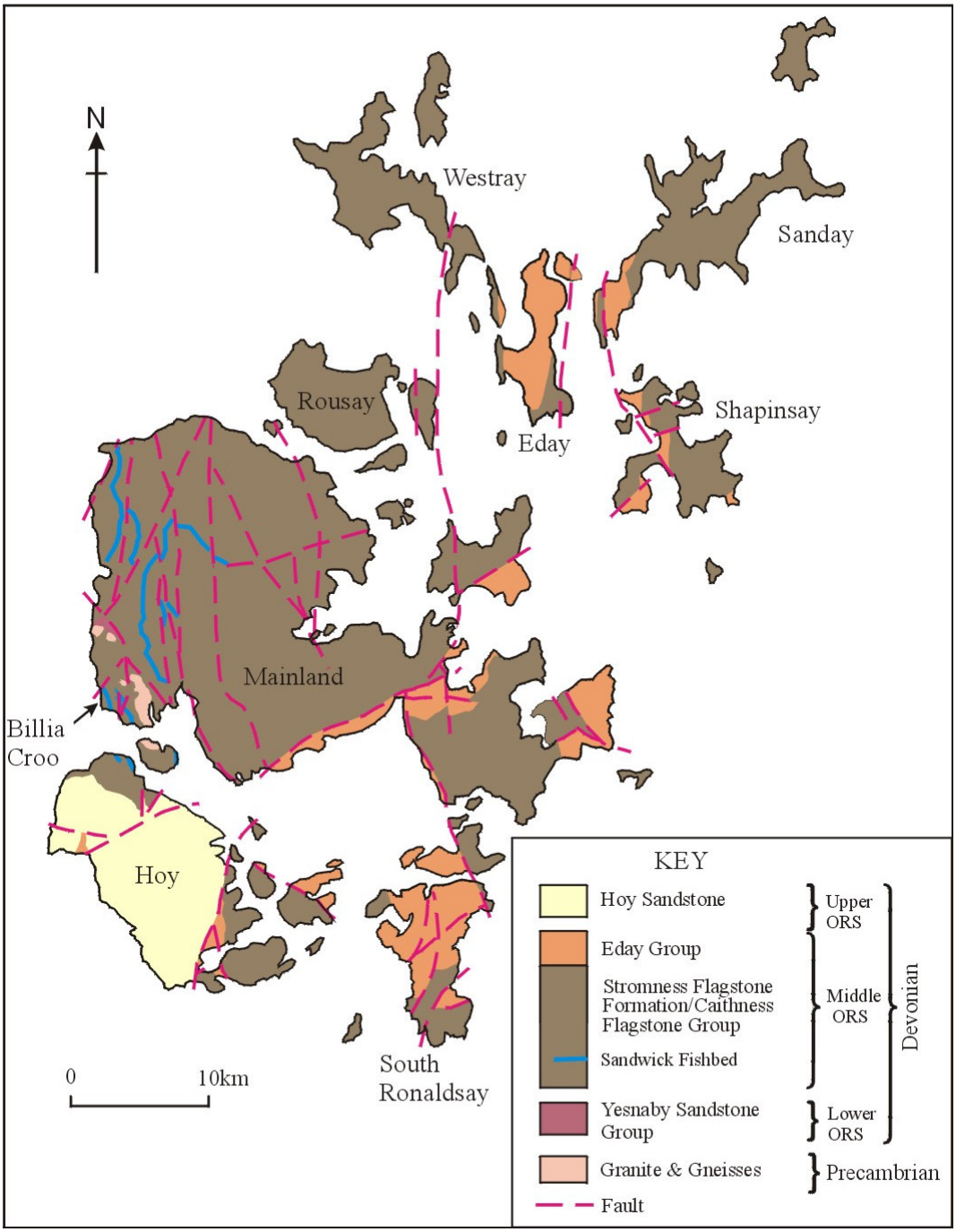

Figure 8.2

During subsequent basin development the Devonian rocks were folded and cut by both normal and reverse faults mostly trending between NW and NE (Fig. 8.3). Final uplift and erosion of the basin occurred prior to the Permian age when an extensive ENE-trending swarm of camptonite dykes was emplaced (Fig.8. 3).

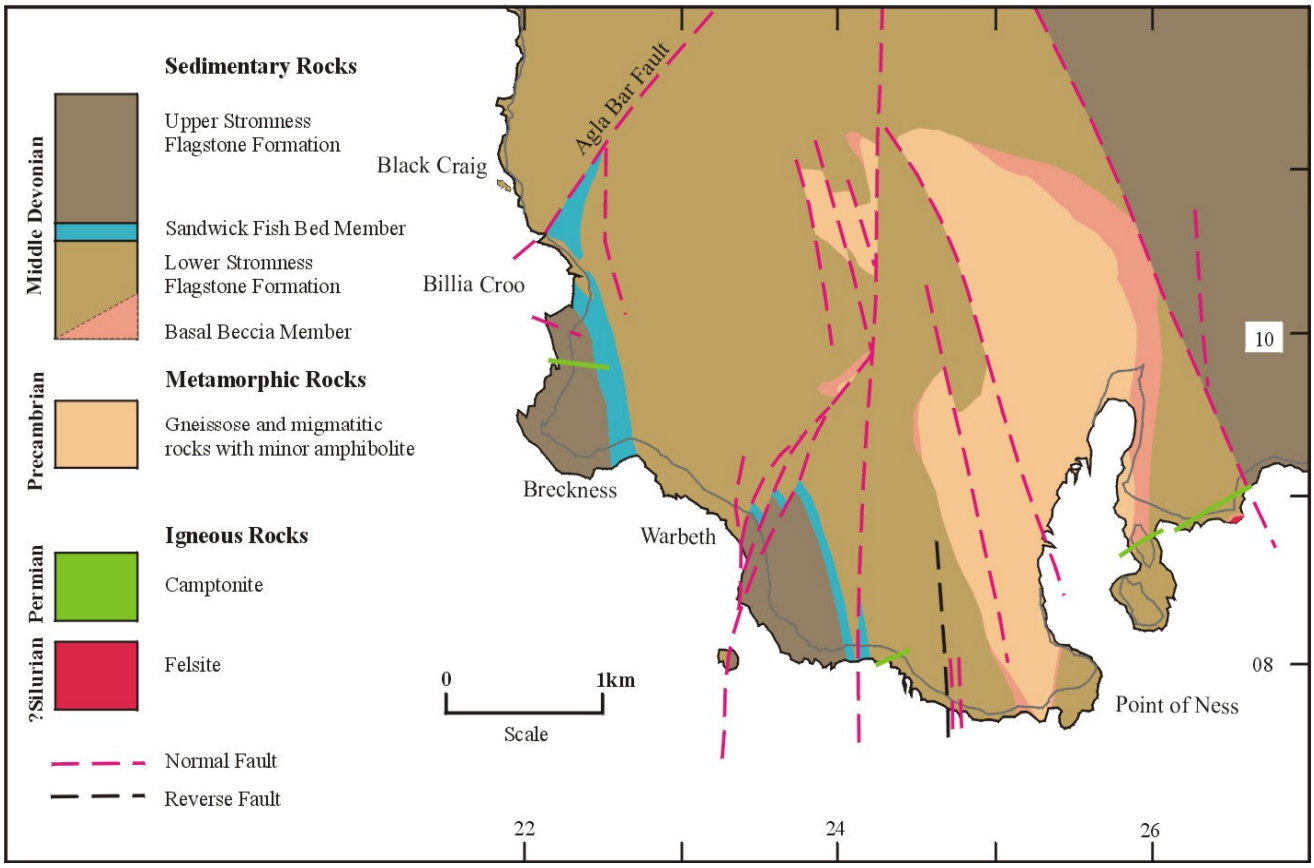

Figure 8.3

Superficial deposits
Successive glaciations in Pleistocene times, associated with the formation and decay of ice-sheets, scoured the landscape on Orkney creating a relatively smooth scarp and dip topography. Glacial striae indicate a general movement of ice to the north-west during the last late-Devensian glacial event. Glacial deposits, up to 10 m thick, mantle much of the lower ground in western Mainland. These consist mainly of reddish or grey clay or sandy-clay diamicton. Blocks and pebbles within these tills are mostly of local rock-types together with shelly marine clays and clasts of Precambrian to Cretaceous lithologies derived from the surrounding seabed. A steady rise in sea level through the Holocene is reflected in the general absence of post-glacial raised beach deposits. Also, former peat bogs are now to be found below the high water mark. Deposits of blown sand and high-level storm beaches are found along exposed coasts. Peat covers much of the upland areas of Mainland.

Economic geology
Metalliferous mineralisation is largely confined to epigenetic lead veins. Most are small and uneconomic but lead was successively wrought from a vein at Warebeth in the 18th century. Enhanced levels of uranium are associated with fish beds, with pronounced concentrations where beds are cut by faults through groundwater leaching. The flagstones of the Stromness formations contain numerous patches of bitumen and hydrocarbon residues, particularly adjacent to or within faults. The

flagstones have been extensively quarried as a source of building materials including building and paving stones and roofing slates.

8.2.2. Site Geology

Geomorphology
Billia Croo is an area of contrasting geomorphology. On the north side of the bay the cliffs, which are up to 100 m high on Black Craig, descend rapidly to around 20 m below which there is a narrow inclined wave-cut abrasion surface. Midway along the north side of the bay the cliff morphology gives way to an extensive abrasion surface, formed along bedding planes in the sandstone, which slope at a gentle angle towards the sea. A low rocky bluff surmounted by an undulating grassy slope backs the platform.

The abrasion surface extends to the centre of the bay, but progressively disappears to the south and west beneath a gently sloping shingle and boulder beach. This extends southwards from the bay head for around 150m. A well-developed storm beach composed mainly of tabular red sandstone blocks backs the beach. The storm beach extends up to the 10 m contour and fronts an arcuate terrace feature approximately 100m long and up to 30 m wide (Photo 8.1). The terrace resembles a raised beach, but borehole evidence indicates it consists of 'soft wet clay with some stones'. The feature may represent either slumped till or spoil from a previously unrecorded flagstone quarry (Photo 8.2). Low cliffs at the back the terrace, contiguous with those to the north and south, are partly obscured by slumped superficial deposits.

Towards the southern extremity of the bay the shingle and boulder beach gives way to a broad, laterally extensive wave-cut platform, in excess of 150 m wide, cut in rocks of the Sandwick Fish Bed Member. The landward end low cliffs that seldom exceed 5 m in height surmount the platform.

Solid Geology
Rocks of the Sandwick Fish Bed Member and Lower Stromness Flagstone Formation, which are seen in both sparse inland exposures, largely underlie the coast at Billia Croo, outcrop in stream sections, and the cliff and coastal fringe. Rocks of the succeeding Upper Stromness Flagstone Formation crop out to the south and west of the site along the coast and margin (Fig. 8.3).

The rocks lie on the western limb of a north-south-trending, large-scale open anticline. The structure is upper Devonian to lower Permian age, with a steeply inclined axial planar surface. Bedding is to the southwest with dips ranging from 8 to 20 degrees, with an average of 12 degrees. At the proposed site for the switchgear station the dip of the bedding is likely to be in the range 8 to 10 degrees.

The upper part of the Lower Stromness Flagstone Formation crops out in sparse exposures in the eastern part of the site and in part of the cliff section towards Whale Geo. This part of the succession comprises interlayering of green-grey massive siltstones and tabular beds of fine-grained, grey to rusty red sandstones. These sandstones are characteristically ripple cross-laminated, while the tops of siltstones generally contain sand-filled desiccation polygons. The siltstones are generally massive, although some internal lamination may occur. Lenticular beds of trough cross-bedded, coarse-grained sandstone, representing channel fills, are locally

present in the sequence. Bed thicknesses are generally less than 0.5m, although the channel sandstones may be in excess of 1m. Ferroan dolomite is the principal cement in these rocks, forming up to 20 per cent of the rock volume.

The Sandwick Fish Bed cycle here is approximately 35m thick. The basal beds, seen striking south-east from Hole o' Row comprise dark-grey calcareous or dolomitic, fish-bearing, silty mudstones, thin rhythmically laminated siltstones and muddy limestones. The actual Sandwick Fish Bed is represented by a 0.5 m thick cream or rust coloured carbonate-rich bed. Identified fish remains include *Cheirocanthus, Diplacanthus striatus, Cheirolepis, Ostoelepis macrolepidotus, Gryoptychius agassizi* and *Dipterus*. Beds of green weathering, illite-dominant, tuffaceous siltstones up to 4 cm thick, in which pyrite and ferroan dolomite have replaced volcanic lapilli material, occur 3.5 m above the base of rhythmite unit. Many of the mudstones are bituminous and are susceptible to bedding plane slip, with some bed surfaces showing slickenside developments.

The overlying rocks in the cycle form, in the main, a gradually upward coarsening sequence of massive slumped and foundered siltstones; laminated to thinly-bedded, graded siltstones and mudstones, and minor massive fine-grained sandstones. Load structures are common to the base of the latter beds. Bed thicknesses, in general, increase upward from centimetre to metre scale. Fossil plant fragment including *Thusophyton, Hostimella* and *Protopteridium* occur in the middle part of the succession.

The upper part of the Sandwick Fish Bed cycle at Billia Croo seen in the northern part of the wave cut platform area is 7 m thick. This is an upward fining sequence comprising mainly thick grey-green siltstones, with interbedded pale grey ripple-laminated sandstones and green-grey siltstones (often with dessication cracks), grey asymmetrically rippled channel and tabular sandstones. The latter have thicknesses up to 0.5 m. The top of the cycle is marked by the incoming of dark silty mudstones with siltstone lenses.

Calcite and/or dolomite are the principal cements of the rocks in this succession. In general, the reddish hues to the rocks are developed were the cement is a ferroan dolomite.

Fractures and faults

The rocks are well jointed, but no systematic study of the joint pattern has been undertaken. On a gross scale, two distinct major joint sets with east to west and north-northeast to south-southwest trends, respectively, are important structural features in these rocks. Both sets are steeply inclined with partings ranging from approximately 20 cm to metre scale. With bedding, these produce a blocky to planar tabular fracture to the rocks (Photo 8.3).

Although no fault structures have been recorded within the site of interest, a WNW-trending fracture outcrops immediately to the east within the Streather Burn at [HY 2252 1027]. The British Geological Survey records give no information as to the inclination of this structure, or neither sense of displacement nor the nature of the fracture zone associated with it. Open fracturing and carbonate vein infills occur extensively within the adjacent flagstone lithologies. Other faults are found within the wave-cut platform to the south of the site, and have a general ENE-trend. A Permian age camptonite dykes occupies one of these fracture zones.

Glacial and recent deposits

A thin layer of till (boulder clay), laid down during late Devensian glaciation, overlies the bedrock across much of the site till. Proven thickness is in the order of 0.5 m (Test Hole 4), but may be variable up to 2 m due to irregularities in the bedrock surface. The till is reddish brown sandy diamicton, containing a high proportion of 'Old Red Sandstone' clasts.

The fringing beach deposits on the southern part of the site rest partly on top of a seaward wave-cut platform, and has a moderate gradient. The northern end of the deposit is terminated by a rock abrasion surface inclined along the bedding plane. The beach deposits are formed mostly of shingle and cobble deposit, comprising well-rounded clasts, with some boulders. This fringes over a deposit of coarse sands with cobbles (e.g. Test Hole 2). A backshore storm beach, comprising mostly of partially abraded tabular clast of locally derived flagstones is locally prominent between 4 and 10 m OD (Photo 8.4).

Mass Movement Deposits
The till deposits overlie a head, a zone of weathered bedrock of less than 1m thick. Evidence of weak coherence in the head, possibly a result of surface water saturation, is seen in the localised development of slumped solifluction deposits. This is well seen at [HY 2241 1018] and [HY 2230 1023] where material appears to have slipped adjacent to a prominent bluff feature in bedrock (Photo 8.5). Test Hole 3, sunk at the northern end of the terrace feature described in 7.2.2.1 cored 5 m of soft wet clay, thought to represent soliflucted till and head or quarry spoil. These may be areas of instability and further creep.

Economic geology
The clifftop flagstone quarry at the northern end of Billia Croo [HY 222 106], which was used as a source of roofing slate, is the only recorded mineral working in the area. However, it is possible that the flagstones were worked in the area of the terrace feature described above.

Groundwater
No ingress of groundwater was found in the landward borehole trials, indicating that saturation water levels are below 2 m from surface.

Seismic history
Orkney and the surrounding area are generally aseismic, suggesting overall stability within this part of the earth's crust. Within historical time, only two seismic events have been recorded within this part of the Orcadian basin. The first recorded event was in 1862 in the Thurso area, while a more recent event occurred to the northwest of Mainland in 1981 of magnitude 2.6 on the Richter scale at a depth of nearly 11 km.

YEAR	MONTH	DAY	LAT	LONG	EAST	NORTH	DEPTH	MAG	LOCALITY
1862	07	03	58.610	-3.650	304.149	970.255	0.0	2.5	THURSO
1981	12	27	59.297	-2.680	361.302	1045.782	10.9	2.6	ORKNEY

8.2.3. Geological conservation

The west and south-west coasts of Orkney Mainland contain features that are of considerable geological and geomorphological significance and as such attract a number of conservation designations including Site of Special Scientific Interest (SSSI), candidate Special Conservation Area (cSAC) and Geological Conservation Review (GCR) sites. This part of Orkney also lies within the Hoy and West Mainland National Scenic Area (NSA).

The shore and cliffs at Billia Croo lies within the Stromness Heaths and Coast SSSI, a designated area covering 755 ha of the coast and hinterland between Bay of Skail and Stromness that encompasses a number of geologically and geomorphological important sites. In particular, it recognises that, as a result of the high-energy wave erosion, the western coast provides the best examples in Orkney of the distinctive sandstone and flagstone cliffs. It also encompasses a range of well-formed rock coast features including various types of cliff forms, caves, arches, geos, stacks, shore platforms and features of cliff-top scouring.

The coastal section in the southern part of the SSSI provides what is regarded as the best section through the Lower and Upper Stromness Flagstone formations, showing a diverse sequence of lake and playa basin sedimentary rocks. The section has provided important geo-environmental information that has led to a greater understanding of eutrophic inter-montane lake sedimentary cycles that characterise the Orcadian Basin. It also includes outcrops of the Sandwick Fish Bed Member, an important horizon in regional correlation and noted as a source of rare fossil fish in the Devonian succession. The quarry at the head of the cliffs at Billia Croo (HY 222 106), originally opened as a source of roofing slate, was one of the earliest localities used by fossil fish collectors; both Hugh Miller and R H Traquair visited the site and obtained large numbers of fossil fish. The quarry and its spoil have been extensively worked over and little of interest remains, although the locality retains its historical significance.

Within the boundaries of the SSSI two areas, Yesnaby and Gaultron, and the South Stromness Coast Section have also been designated Geological Conservation Review (GCR) sites. Billia Croo lies between the two sites but contains many correlatives of the latter site, most notably the Sandwick Fish Bed Member.

8.3. Potential Impacts

The proposed development has the capacity to impact on the geology of Billia Croo in two respects:

1. Excavation of the site for the underground switchgear building.
2. Routing of the cable ducts between landfall and the switchgear building.

Site conditions at the proposed site for the underground switchgear building are likely to comprise till (boulder clay) overlying head and bedrock of Middle Devonian flagstones. The till is unlikely to exceed 1-2 m in thickness, so the foundations of the building will require excavation to a depth of at least 3 m in bedrock.

As the actual site will remain static and be largely unaffected by wave action after completion, it is unlikely that it will have any adverse effect on geology particularly with regard to its importance within the context of the SSSI. Rather the site could, by providing fresh exposures, enhance the geological value of the site, especially if it exposes fossil-fish-bearing rocks.

Although the proposed site for the switchgear station is well above storm beach height, continuing wave action on the low cliffs below could still have a serious knock-on effect on the site. This stems from the seaward dip of the flagstones underlying the site leading to slumping of the overlying till, as evidenced in the

terrace area to the south, and more seriously to bedding plane slip giving rise to landslip.

Directly seaward of the proposed site the low rock cliff is fronted by the southern end of the sloping abrasion surface. Trenching across such rock features could result in significant visual impact. Hence, sympathetic reinstatement might be difficult in such an environment.

8.4. Mitigation Measures

Care should thus be taken throughout the excavation phase of the underground switchgear station to ensure that during excavation, the site should be logged in detail and the excavated rock spoil is examined geologically and palaeontologically before reuse.

8.5. Residual Impacts

Local knowledge indicates that considerable movement of the beach occurs during successive storms, although it is not know to what depth this extends. As a consequence, if the cables are laid across the shingle, close monitoring of the beach might be required in the early stages. On the other hand, wave action may reduce in the long term. At present, the rate of isostatic rebound in northern Scotland currently exceeds the rise in sea level due to global warming; the current trend in this part of the United Kingdom is a net fall in sea level of 1-3 mm/year.

9. Archaeological Heritage

9.1. Introduction

This section of the report comprises the archaeological component of the assessment and aims to:

- Describe the known archaeological sites and the potential for unknown sites;
- Assess potential impacts and their significance;
- Identify measures to mitigate any adverse impacts or areas where further evaluation may be required.

An archaeological assessment was carried out using this framework. The methods and results are summarised below and the following resources were utilised:

- National Monuments Records of Scotland web site 'CANMORE':
- Orkney Sites and Monuments Record (SMR) based at Orkney Archaeological Trust (The staff were also consulted);
- cartographic sources (historic and contemporary);
- walkover survey.

The assessment has allocated a level of significance to the identified sites of interest based on factors including period, condition, rarity and vulnerability. Taking into account the presence of a burnt mound and cairn located to the east of the proposed Billia Croo site, and the potential associated features surrounding them.

9.2. Scope and Objectives of the Study

The selected development area for the proposed new switchgear building and its access road is located in a field south of the Black Craig. It is currently partly improved wetlands pasture surrounded by improved pasture with improved pasture with unimproved heather moorland on the slopes, ranging in altitude from around 20 m 111 m OD. The underground cables are located on the steep heather slopes on the east side of Black Craig to the north of the Billia Croo site.

The survey area covers approximately 25 hectares to the south and on the east slopes of Black Craig (HY22051099), in the south of the hills to the NW of Stromness (Appendix F, Figure 5.1).

The study aims to:

- describe the known archaeological sites and the potential for unknown sites;
- assess their significance;
- assess potential impacts and their significance;
- highlight areas where nothing is known that need further investigation; and
- identify measures to mitigate any adverse impacts or areas where further evaluation may be required.

An archaeological assessment was carried out, based on the framework of the aims above.

The initial assessment was based on the documented sources (listed below) and information gained from a walkover survey. The identified sites were graded in importance taking into account the known sites within the survey area, these are outwith the proposed development footprint.

The desk top assessment used the following data resources:

National Monuments Record of Scotland
The National Monuments Record of Scotland web site 'CANMORE' was visited online to retrieve relevant data held there on any known sites including the burnt mound within the field and Breck Ness sites to the south. There are no RCAHMS aerial photographs of the development area as yet.

Orkney Sites and Monument Record (SMR) based at Orkney Archaeological Trust
The Sites and Monuments Record was visited to retrieve information held regarding the burnt mound and cairn and to check other records to investigate if any other features were known within the survey area. The 1:10,000 map overlays were viewed and the staff were also consulted. The aerial photographic archive held here was also consulted though unfortunately the aerial views just clip the Black Craig area.

Cartographic sources (historic and contemporary)
Ordnance Survey 1:10,000 maps were consulted with the National Monuments Record of Scotland overlays, as were the 1902 2nd edition Ordnance Survey maps. The first edition Ordnance Survey maps were viewed on-line.
The Ordnance Survey 1:50,000 map was studied and used as a base for one of the location maps.

Walkover survey
A walkover survey was undertaken which focussed on the new development area and its immediate surrounding area, including the burnt mound, the line of the underground cable was also walked over.

9.3. Methodology

The initial assessment was based on the documented sources and information gained from a walkover survey. The identified sites were graded in importance taking into account the known sites within the survey area, this lies out with the development footprint.

The following factors formed the basis of the analysis:

- dating; period and whether multi-period or single period;
- state of preservation;
- rarity and value of potential associated features;
- location within landscape;
- vulnerability from land use and other threats; and
- Published records.

Given the limited available information, due to the lack of work undertaken in this area, the assessment was based on professional judgement, and drawing parallels from the results of work done on similar monument types within Orkney.

9.4. Archaeology

Results of Desk Based Assessment:

a) The search of available archives indicated that no aerial photographs of this area exist.
b) Only one known monument and one potential monument exists in the area to be surveyed. Extracts from references to this monument are given below. A large multi-period cluster of sites, including a broch, is located 1 km to the south and aerial photographs show potential archaeology in the hills to the east.

Burnt Mound (HY21SW5) [NMR SW5, OR 1482]
A 1.7m high grass covered mound, measuring 34.0m NE-SW by 9m E-W in which there are traces of burnt earth and stones. The Burn of Streather has been diverted and is no longer eroding the mound. No finds have been reported from the area and there are no traces of any associated structures. **OS(RD) visit 1964**
The mound surveyed by OS(RD) appears to be composed mainly of earth, but in its SE side are traces of burnt material. It would seem that there has been a burnt mound here, and that it has been almost totally eroded away by the stream. **OS(AA) visit 1973**

Cairn (HY22751059)
No further information. Marked on maps as cairn. On my visit the area was under long grass and not accessible.

9.4.1. Results of Walkover Survey

No other definite upstanding archaeology was identified in the immediate vicinity, though a large part of the area is undulating and may be remnants of other small burnt mounds and watercourse features. The burn itself has an artificial pool created using upright flags, this lay approximately 48m down stream of the mound. Any interpretation of this area must include recognition of the potential for unrecorded features, including features below the peat-rich topsoil and features hidden within the wetlands and heather.

9.4.2. Discussion of Survey Results:

The main area of the survey, where the switchgear building would be located, contains only one known archaeological site. This is a burnt mound (HY21 SW5 or 1482), which lies outwith the area of intrusive development. This monument is of local importance and with the presence of features in the burn the potential for other features is high. The development footprint of the switchgear building is on potentially disturbed ground, which has some fresh disturbance, and is in close proximity to the mouth of the burn and the accessible shore. This location has archaeological potential for boat landing features and finds washing out down the burn.

The second area, where the underground cables would be located on Black Craig Hill, had one wartime feature and the disused coast guard house, the immediate surrounding area had no or unknown sites.

9.5. The "Naming Stone"

The 'Naming Stone' is situated at the north end of the bay at Billia Croo. It is sandstone cliff that has traditionally been inscribed with the names (and dates) of local people who have visited the site over recent centuries. Although not specifically of archaeological heritage, it can be considered a site of local culture importance.

Works associated with the installation of facilities for the proposed Marine Energy Test Centre will not damage or interfere with the inscribed cliff.

9.6. Potential Impacts

The impacts that are taken into account here include

- Destruction; directly by the ground breaking works; or
  indirectly; by changes in drainage, subsidence
- Truncation: from associated surrounding features;
- Visual; of immediate local area;
  and the wider view as the summit is prominent

The greatest potential impacts would be on the unknown, hidden archaeology within all the areas of ground breaking works, in the field and along the routes of the access road and underground cables up to the summit of Black Craig Hill, especially as the depth of destruction would be such as to remove any potentially surviving feature.

The development would potentially truncate and destroy features within the field relating to the burnt mound and with the access track improvement the area around the cairn is also under threat. No direct or indirect impacts would cause any threat to the known burnt mound, as the land use at present has already partly altered the land drainage.

9.7. Mitigation Measures

Although the main construction works of this development are not a threat to the known and visible archaeology. Any intrusive development within an area with known archaeology requires an assessment or evaluation to determine whether the damage will be destructive or a minor threat. Therefore a watching brief for any ground breaking works, is proposed, to monitor the archaeology and 'rescue' any archaeological remains.

To minimise intrusion into the ground along the access track to the switchgear building, it is proposed to construct the track above existing ground level, without excavating the ground beneath the track, other than for the installation of the adjacent land drain and cabling.

10. Traffic and Access

10.1. Introduction

The main traffic impact of the proposed development will be due to construction work for the new access track and switchgear building at Billia Croo. This is due to the fact that this element of the development will require road stone brought to site to upgrade and extend the existing access track and concrete and steel reinforcement to construct the switchgear building.

Very few construction materials are required to upgrade the old coastguard building at Black Craig and these will be delivered to site either on foot or by low ground pressure “quad” bikes.

Additional construction traffic to refurbish the rooms within the Old Academy in Stromness is unlikely to be significant due to the relatively small amount of work required, the temporary increase relative to existing traffic levels and the fact that access is gained from a main road.

As noted above, the only part of the test centre which will be permanently staffed and hence generate daily traffic during it’s operation, is the control centre in the Old Academy building. It is anticipated that it will be permanently staffed by a maximum of two or three local people employed by the test centre operating company. From time to time representatives from companies testing the off shore generating devices will work from the centre. It is anticipated that there is sufficient existing parking provision in the grounds of the Old Academy to accommodate the extra demand.

10.2. Existing Conditions

Access to the Billia Croo and Black Craig sites are from a macadamed single-track public road which currently provides access to individual houses and farms in the Outertown area, to the west of Stromness. This road comes to a dead end at the foot of Black Craig hill.

An existing farm track runs from the end of the public road to the fields in the vicinity of the switchgear building at Billia Croo. Access to the old coastguard building at Black Craig is along a hardcore access track which runs for a few hundred metres from the end of the public road to the house and farm steading, Fletts. Beyond this point, access is gained by foot across a field, over a stile and across heathland that is part of the Site of Special Scientific Interest.

10.3. Potential Impacts

10.3.1. Construction

The existing farm track has to be upgraded and extended in order to construct the new switchgear building at Billia Croo. This will require bringing to site approximately 900 tonnes of roadstone, 8 tonnes of steel reinforcement and 200 tonnes of concrete. In addition it will generate daily traffic taking men and equipment to site.

10.3.2. Operation

Intermittent maintenance and inspection visits will be require to both the building at Billia Croo and on Black Craig hill.

10.3.3. Sight Seeing

As noted above, mooring of the generating devices off shore is likely to generate interest from both the local community and from further afield

The main impacts from the site seeing activities will be twofold. Additional traffic will be generated on the single track public road from Stromness and parking may be problem where the public road comes to a dead end. Also, pedestrian access up Black Craig hill, over the Special Site of Scientific Interest, will cause disturbance to the existing farmland and habitat. The extent of which will depend on the number of sightseers.

10.4. Mitigation Measures

10.4.1. Construction

To minimise the amount of road stone required to construct the access track from the end of the public road to the switchgear building at Billia Croo, it is proposed to use a geogrid as part of the track construction. This is a plastic mesh reinforcement, which is unrolled on the existing ground surface and allows the track to be constructed without excavating the existing topsoil and reduces the amount of road stone required for the track. By acting in unison with the road stone, it spreads the wheel load from the construction traffic and reduces in the quantities of road stone required to construct the track by up to 40%.

In addition, the material excavated to allow the switchgear building to be located underground will be reused locally around the building to reinstate the overall landform and topsoil around the new building. No excavated material will be removed from the site.

10.4.2. Operation

The facility has been designed to be operated from the control centre in the Old Academy in Stromness, thus limiting the traffic to the other parts of the facility to intermittent maintenance and inspection visits only.

Maintenance and inspection visits to the old coastguard building on Black Craig hill will be limited to pedestrian access.

10.4.3. Sight Seeing

There are plans for the Orkney Renewable Energy Forum to have a permanent exhibition, which will include information on the Marine Energy Test Centre. Whilst it likely that this will reduce the numbers of visitors to the site, it is likely that some sightseers will still travel to Outertown and climb Black Craig hill to view the off shore generating devices.

As the number of visitors to the site is difficult to predict, it is proposed that the situation is monitored and if there are significant numbers, which cause problems with parking at the end of the public road, or access onto Black Craig hill then measures will be implemented to address these issues.

10.5. Residual Impacts

10.5.1. Operational

Maintenance and inspection access to the switchgear building at Billia Croo will be by van or four wheel drive vehicle.

Maintenance and inspection access to the old coastguard building at Black Craig will be by foot.

10.5.2. Sight Seeing

There will be additional traffic, generated by sightseers, between Stromness and the end of the public road at the foot of Black Craig Hill. There will also be additional pedestrians using the track from the end of the public road, to the old coastguard building on Black Craig Hill.

11. Operational Environmental Framework

11.1 Introduction

Marine renewable energies have been viewed as an environmentally beneficial way of generating power in the future. Nevertheless, the installation of any system in the marine environment has the potential to impact on that environment and other users of the area. It is necessary therefore to manage the activities associated with marine renewable energy exploitation in a careful and enlightened manner in keeping with modern principles of sustainable development. Basic elements of such an approach include establishing environmental and social policies for the project and creating an integrated management system that embeds these considerations at the core of the decision making. This section of the Environmental Statement therefore recommends how environmental management can be incorporated into the operation of the test facility.

It is also recognised that this Environmental Statement, produced in support of licence applications for the establishment of the test facilities, will not necessarily be able to predict all the specific impacts relating to individual test devices.

11.2 Environmental management system

Environmental management of the project up to the time of submission of this Environmental Statement is achieved primarily through the environmental assessment process. It must be emphasised that environmental assessment is an ongoing process, which will continue following submission of the Environmental Statement

It will encompass the consideration and adoption of mitigation measures highlighted, further stakeholder consultation and a more focussed assessment of the environmental aspects of individual test devices. The primary mechanism for ensuring that environmental assessment continues and that all environmental issues are managed, is through an Environmental Management System (EMS) (see Figure 11.1 overleaf). This indicates how the responsibility for implementing the environmental measures will transfer from the design and construction team to the facility operator.

Figure 11.1
Environmental management throughout facility construction and operation

Implementation of Environmental Statement mitigation measures by the Design and Construction Team during the establishment and construction of the Marine Energy Test Centre			
	Final design	**Construction**	**Operation**
Production of Environmental Statement containing proposed mitigation measures	√		
Implementation of mitigation measures	√	√	
Continued consultation	√	√	
Legal and consenting requirements	√		
Incorporation of Environmental Statement mitigation measures into final design	√		
Implementation of Environmental Statement mitigation measures commitments during construction		√	
Development and implementation of Marine Energy Test Centre Environmental Management System by the Facility Operator			
	Final design	**Construction**	**Operation**
Establishment of Marine Energy Test Centre operating company	√		
Production of environmental policy	√		
Consultation	√	√	√
Production of management system documentation	√	√	
Legal and consenting requirements (for each device)	**Develop Strategy**	**Develop Procedure**	
Environmental assessment of each company/device	**Develop Strategy**	**Develop Procedure**	
Establish maintenance services/contracts		√	
Emergency preparedness and response	**Develop Strategy**	**Develop Procedure**	
Establish emergency response services/contracts		√	
Implementation of mitigation measures			√
Environmental monitoring	**Develop Strategy**	**Develop Procedure**	**Research Studies**

As part of the operation of the Marine Energy Test Centre it will therefore be imperative that an Environmental Management System is developed and implemented. This Environmental Management System can only be developed once the operational philosophy for the Marine Energy Test Centre has been established and the Marine Energy Test Centre operating company is in place. At this stage it will be possible to develop an environmental policy and plan the implementation of the Environmental Management System to ensure it is an integral part of and fully integrated within the operational procedures and philosophy of the Marine Energy Test Centre.

11.2.1 Implementation of Environmental Statement mitigation measures during final design, construction and operational.

As a result of this environmental assessment an action checklist has been produced (refer Appendix G) which documents all mitigation measures identified and detailed

in this Environmental Statement. These commitments will need to be incorporated into the overall project management system to ensure they are carried through. It is expected this action plan will evolve and be updated as the project continues into the operational phase.

11.2.2 Consultation

During the environmental assessment there has been consultation with local and other stakeholders with regard to various aspects of the Marine Energy Test Centre and a number of constructive communication channels have been established. These should be maintained throughout all phases of the project (a list of consultees during the environmental assessment is provided in Section 3.3).

This is a 'first of its kind' development it will be important that thorough consultation takes place with regard to issues that may set a precedent for future developments e.g. consent process of individual test devices, navigational requirements including establishment of any exclusion zones around offshore devices.

One particular area of concern that has been highlighted during consultation is the potential for harbour congestion, therefore ongoing consultation with OIC Harbours Department and early notification of likely harbour requirements is imperative.

11.2.3 Environmental assessment of individual test devices

All companies making use of the test facility will be expected to demonstrate commitment to Health, Safety and Environmental (HSE) issues and have systems in place for managing HSE.

As stated above there is yet to be final agreement on the consenting procedure for the individual test devices, however within the requirements of the Marine Energy Test Centre EMS, there will be a requirement for each developer to undertake a device specific environmental assessment prior to receiving final consent for installation of the device. The expected content of these assessments and the general environmental requirements for test devices are outlined in Table 11.1 below. The Marine Energy Test Centre Operating Company will incorporate these requirements into an 'environmental approval procedure'.

Such assessments will be independently reviewed and specific management or mitigation measures implemented where necessary.

Table 11.1 Environmental assessment requirements for specific devices

Specific devices requirements from an environmental perspective
1. ***Offshore mooring requirements*** – developers will be expected to design mooring requirements to minimise potential environmental impact e.g. interaction with other sea users and avoidance of excessive seabed excavation/modification.
2. ***Oil use/discharge*** - where devices require the use of hydraulic oils, use of 'environmentally friendly' oils will be expected. Wherever possible hydraulic oil systems should be closed systems to avoid discharge to the marine environment.
3. ***Chemicals and paint*** – where chemical and paint use is required, companies must provide evidence that they are using as environmentally benign products as possible (without compromising technical performance). Particular attention will be paid to any proposed antifouling requirements.
4. ***Waste disposal*** – companies will be required to demonstrate that they have considered any waste disposal issues. Waste disposal requirements beyond those routinely available in Orkney should be identified and suitable waste disposal procedures in place.
5. ***Harbour/inshore mooring facility requirements –*** provide details of, and agree arrangements for, any harbour or inshore mooring requirements with the test centre operators/OIC Harbours prior to devices arriving on site.
6. ***Emergency response procedures and contingency arrangements*** – see section 11.2.4.
Minimum content requirements for device specific environmental assessments
1. Provision of a full description of the device (including copies of engineering drawings), its mooring requirements and details of proposed installation and test schedule.
2. Expected use of local resources due to the presence of the device in Orkney and the 'influx' of non-local resources from the test company. This should include requirements for harbour facilities and inshore mooring and potential contractor services e.g. vessel or engineering support.
3. Results of any previous environmental assessment or monitoring work related to the device.
4. Inventory of all materials of which the device comprises (including their nature and quantity).
5. Details of any discharges from the operation of the device (e.g. oils and/or chemicals).
6. Details of any anti fouling measures.
7. Visual characteristics of the device including proposed/agreed navigational markings (buoys, lights etc).
8. Noise characteristics of the device (frequency and expected peak intensity if available).
9. Details of waste disposal requirements.

11.2.4 Emergency preparedness and response

As with any development, there is the potential for accidental and emergency events. It will be imperative that for every device to be installed at the Marine Energy Test Centre a risk assessment is undertaken to identify such potential events, and that approved contingency and recovery plans are in place. The risk assessment should include consideration of (but not be limited to) the following:

- Device loss (including beaching);
- Mooring loss;
- Vessel collision;
- Risks from debris interaction/damage (e.g. fishing net, flotsam, jetsam);
- Pollution incident (e.g. oil spill/leak); and
- Energy sink in the event of grid unavailability.

It is recommended that the operating company of the Marine Energy Test Centre has certain basic contracts/agreements in place which will ensure the availability of certain emergency response requirements e.g. 24 hour tug call out, resources for device recovery and means of reporting/notification of the incident (in particular to advise local mariners).

The details of these will be provided to each testing contractor so that they can be included within their device specific emergency response arrangements.

11.2.5 Environmental monitoring

In addition to individual device performance, it will also be important to monitor any environmental effects of the developing technologies. These monitoring studies will require additional resources and funding.

Specific gaps in knowledge of potential impacts identified to date include:

- Potential impacts from loss of energy in the marine environment on coastal processes and
- Potential impact of noise on cetaceans and other marine wildlife.

Such research data will be important to developers in order to support future applications for the development of larger scale commercial offshore projects.

12. Summary and Conclusions

Through the proposed investment by Highlands and Islands Enterprise in the development of a Marine Energy Test Centre at Stromness, the opportunity exists for Orkney to lead the development of a new off shore energy industry. The development of a marine energy industry provides the opportunity to bring investment and employment to the less favoured areas of Scotland.

The proposed test centre will allow full scale generating devices to be tested under normal operating conditions and allow the generating capacity and performance to be independently verified. The infrastructure, which is required to provide an electrical connection from the test devices off shore, to the main electrical grid is therefore a small scale precursor of the type of development which will be required, should devices tested on this site prove commercially viable.

The site selected, due to it's proximity to a suitable off shore wave regime and connection into the main electrical grid, has the disadvantage that elements of the infrastructure for the centre are located on or cross areas which are identified as Sites of Special Scientific Interest (SSSI), candidate Special Areas of Conservation (cSAC) and also a National Scenic Area (NSA).

Efforts have therefore been made in identifying potential environmental impacts of the Test Centre and minimising their effects. Following on from the environmental scoping study that was carried out at design feasibility stage, baseline studies were carried out for four key areas; namely off shore ecology, on shore ecology, geology and archeologically heritage. In addition a range of other issues have been analysed, such as visual impact, traffic, landuse, fisheries and socio-economic aspects. From this work, the potential impacts of the development have been identified and monitoring and mitigation measures proposed. In addition, a section has been included which describes the operational environmental framework for the test devices, which will be moored on the facility.

During the compilation of this report, the project has been discussed with a range of stakeholders and interested parties and, cognisance taken of their views.

From this work, we have endeavoured to demonstrate that by adopting the monitoring and mitigating measures identified, this facility can be accommodated into the existing unique environment without causing disproportionate environmental impacts.

13. References

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Vella G, Rushforth I, Mason E, Hough A, England R, Styles P, Holt T and Thorne (2001). Assessment of the effects of noise and vibration from offshore wind farms on marine wildlife. A report produced by the University of Liverpool, Centre for Marine and Coastal Studies Environmental Research and Consultancy.

14. Photographs

Photographs of Billia Croo Site

Photographs of Old Coastguard's Building, Black Craig

Undersea Photographs along the Proposed Cable Route

15. Photomontages of the Proposed Switchgear Building at Billia Croo

16. Drawings

1543/01	Site Reference Plan
1543/50	Billia Croo Site Layout
1543/51	Switchgear Building General Arrangement
1543/52	Proposed Earthworks at Billia Croo
1543/54	Propose Location of Off Shore Generating Devices
1543/55	Proposed Works at Black Craig

17. Appendices

Appendix A Environmental Scoping Study

Appendix B Design and construction organisations involved in project

Appendix C Organisations which assisted Carl Bro in the preparation of the Environmental Statement

Appendix D Responses and notes of meetings with consultees and interested parties

Appendix E Site of Special Scientific Interest and candidate Special Area of Conservation

Appendix F Habitat mapping of coastal area around Billia Croo

Appendix G Project environmental action checklist